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MODEL AIRPLANE NEWS

AND JUNIOR MECHANICS

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Compressed Air Motor Plans

-:-

Tandem Endurance Model Plans

-:-

Airistocrat Scale Flying Model Plans

JULY, 1931

A Morane-Saulnier (French) and a Taube (German) in Combat—*World War*

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MODEL ENGINEERS:

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WITH
MODEL AIRPLANE NEWS

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2. *Australia*
3. *Philippine Islands*
4. *India*
5. *China*
6. *Japan*
7. *Russia*
8. *Hawaii*
9. *Vancouver Island*
10. *Alaska*
11. *Yukon Territory*
12. *Canada*
13. *Mexico*
14. *Great Britain*
15. *Germany*
16. *France*
17. *Switzerland*
18. *Italy*
19. *India*
20. *West Africa*
21. *Brazil*
22. *British Guiana*
23. *Trinidad*
24. *Virgin Islands*
25. *Porto Rico*
26. *Jamaica, B. W. I.*
27. *Cuba*
28. *Canal Zone*
29. *Turkey*
30. *Sweden*
31. *Newfoundland*

MODEL AIRPLANE NEWS has made a perfect landing in every corner of the globe. Look at the map above. All those lines, with New York, the home of MODEL AIRPLANE NEWS, as the starting point, represent hundreds of readers in the foreign countries designated. Why? Because MODEL AIRPLANE NEWS is just "another" Aviation Magazine?

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Then there are our covers; Ever see anything like them? Beautifully finished paintings of wartime planes in action. Look at them—they stand out on the news stands. Notice how we have purposely framed them. There is not a word of type on them. Why? So that you can cut them out and have them framed to hang in your den. Bet you never even thought of that!

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Model Airplane News

AND JUNIOR MECHANICS

Vol. V No. 1

Published by Harold Hersey

Edited by Capt. H. J. Loftus-Price

CONTENTS

JULY, 1931

In Our Next Issue

We told you last month that we would have a lot of surprises for you in this issue. True to our word, here they are: a three-view layout of the wartime S.E.5; biographical sketches of Rene Fonck and Ernst Udet, famous fighters in the World War air conflict; and the monster slogan contest we are launching with real cash prizes.

Not bad, is it? We think we'll do the same stunt this month and give you just a partial idea of what the August issue has in store for you—and then spring some big surprises in addition. Sorry, but it's our idea of a good time all round—and something tells us you agree with us.

First, let's tell you about the Quarter Mile "WHAT-IS-IT?" model airplane plans. Remember Dick Cole and his Multiple Rubber Band Motor? Well, Cole built this "WHAT-IS-IT?" and it will amaze you. The model can R.O.G., it's a tractor in the sense that it pulls, and it's a commercial because the motor is enclosed. Wait and see what it is.

Then there's a set of plans and instructions for making a B.F.W.M23c low-wing model. This is a miniature of the famous German monoplane which won the round-Europe flying honors last year. Prof. T. N. de Bobrovsky, who has given us such marvelous designs, built the model and tested it in his own wind-tunnel. It's great!

In addition you'll find plans for a nice little hydroplane which rises and lands on water. This will make a natty addition to your model collection.

Many of you have perhaps been under the impression that the tailless airplane is a recent invention. Ray Wardel, our cover artist, however, takes you back to 1915 with an impression of a BURGESS-DUNNE TAILLESS SEAPLANE submarine-spotting in the North Sea.

As for the rest, we won't say more than that every article is up to the high standard which has been set by MODEL AIRPLANE NEWS. Enough said for the time being.

Don't forget to order your August MODEL AIRPLANE NEWS now. On all news stands July 23 next and only 15c a copy.

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WE WANT A SLOGAN!

$100 IN PRIZES FOR 10 WORDS!

THE PRIZES WILL BE GIVEN FOR THE BEST SLOGANS SUBMITTED.

MODEL AIRPLANE NEWS modestly claims the distinction of being the only magazine of its kind in the world today. From time to time the magazine is referred to as, "*The Wonder Magazine of the Air*," and "*A Stepping Stone to Success in Aviation.*"

Frankly, we want to tell the world about this—featured on our front cover—so it has been decided to let our readers submit, in their own words, a slogan that will convey the type and content of MODEL AIRPLANE NEWS to the prospective purchaser.

Here are a few pointers that might help you in a game of words for which MODEL AIRPLANE NEWS will pay cash!

MODEL AIRPLANE NEWS is of educational interest to everyone—boy and girl, man and woman.

Each month for only 15 cents its readers obtain an instalment of a

Course in Airplane Engineering.
Course in Aerial Radio
Course in Airplane Designing
Two or more sets of scale plans for flying and solid models
And a thousand and one things which make model airplane building the cornerstone of a successful career in aviation

The policy of MODEL AIRPLANE NEWS is not to encourage or teach its readers to become pilots alone, but also to prepare them for careers as aeronautical engineers, designers, salesmen, manufacturers, or equip themselves for any other positions in the gigantic industry of the near future.

Can you embody all this and more in a sentence of not more than ten words? We want something short, snappy and to the point! If you can do this, you will be in line for prizes as follows:

First Prize . . $50 in cash

Second Prize . $25 in cash

Third Prize . . $15 in cash

Fourth Prize . $10 in cash

RULES

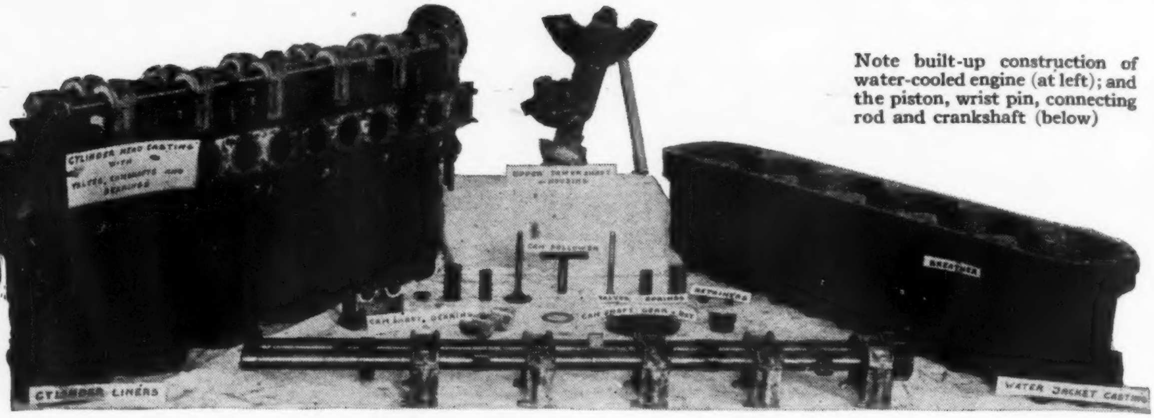
There are no strings to this contest. All we want is a slogan and nothing more. The rules are simple but rigid. Here they are:

1. There is no entrance fee.
2. The contest starts with publication of the July issue of MODEL AIRPLANE NEWS.
3. The closing date is July 14, 1931. After midnight of that day no entries will be eligible for a prize.
4. The judges' decision will be final.
5. No correspondence whatsoever will be entered into concerning the contest.
6. The contest is open to anyone except employees of MODEL AIRPLANE NEWS and/or GOOD STORY MAGAZINE CO., INC., or its associates.
7. The slogan must not contain more than 10 (ten) words.
8. The names of the winners of the contest will be published in the first possible issue of MODEL AIRPLANE NEWS after the closing date of the contest.
9. The judges are Harold Hersey, publisher of MODEL AIRPLANE NEWS; Capt H. J. Loftus-Price, editor of MODEL AIRPLANE NEWS; and Herbert S. Clark, business manager of MODEL AIRPLANE NEWS.
10. Slogans may be written on the back of a postcard, or in a letter, by hand or typewritten. The card or letter must bear, also, your full name and full postal address, clearly printed or typewritten.
11. MODEL AIRPLANE NEWS reserves all rights to the winning slogans, and to the use thereof.
12. You are not limited to one slogan. Send in as many as you like, provided they are sent in separately.
13. Should two or more persons submit the slogan considered best, second best, etc., each will be awarded the prize tied for.

Address your entries to:

THE SLOGAN CONTEST EDITOR
MODEL AIRPLANE NEWS
ROOM 1901
570 SEVENTH AVENUE
NEW YORK CITY

That's all! Now let us hear from you as soon as possible. Get busy with the old bean and go full out for one of these prizes.



Note built-up construction of water-cooled engine (at left); and the piston, wrist pin, connecting rod and crankshaft (below)

The Airplane Engine

By Lieut. (jg) H. B. Miller

THE cylinder of the internal combustion engine is the foundation of its power-producing ability. It has many opposing functions. The cylinder is a compromise which must handle a given situation to the best of its ability. It is a barrel-like mechanism with a smooth inside surface on which the piston can slide up and down. A charge of fresh gaseous fuel must be drawn in, ignited, and exhausted.

The strength of construction must be such that the powerful expansion of the gases can push the piston downward rather than blow the cylinder head off. The design must be such that the tremendous heat may be closely kept within well-defined limits. In spite of these many requirements, it is necessary that the weight be kept to a minimum.

The heat of explosion may run between 2,000 and 3,000 degrees F., while the cylinder walls will often run around 500 degrees F. Unless suitable steps are taken the piston would soon get so hot it would freeze; that is, it would expand and consequently would be too large to move freely within the cylinder liner.

There are many ways of cooling the cylinders of the airplane engine. The earliest system ever used was what is now termed the air-cooled method. Afterwards water cooling came into use as greater power and its resulting increase of heat was developed. After the war, thanks to the United States Navy which needed badly a light engine for use on shipboard planes, Charles Lawrence received sufficient backing to develop his radial air-cooled engine.

This powerplant was later taken over by the Wright Aeronautical Corporation and brought up to its present high state of efficiency. The use of the air-cooled engine has increased many times over since Lindbergh's successful flight across the Atlantic. In fact, one seldom sees a water-cooled engine mounted in a commercial plane.

There are many people who still think that the liquid cooled powerplant may make a come-back. The United States Army has experimented extensively on this problem and have produced a liquid commercially known as Prestone. The many details of the various methods of cooling will be discussed more fully in a later article. We merely offer this information now in order that a student will understand that the liquid-cooled engine is not obsolete.

The standard air-cooled cylinder in use today consists of a steel liner. At the bottom of this are hold-down lugs which secure the cylinder to its base on the crank case. Screwed and shrunk on the top of the liner is an aluminum head. This provides the combustion space which is most carefully designed. The intake and exhaust valve ports are cast into the aluminum head.

In addition, cooling fins are cast or machined around the circumference and exhaust port. This material is insufficiently hard to provide a seat for the valves, so aluminum-bronze alloy valve seats are shrunk into place. In order to secure further cooling the steel barrel has cooling fins machined on its length not covered by the aluminum head.

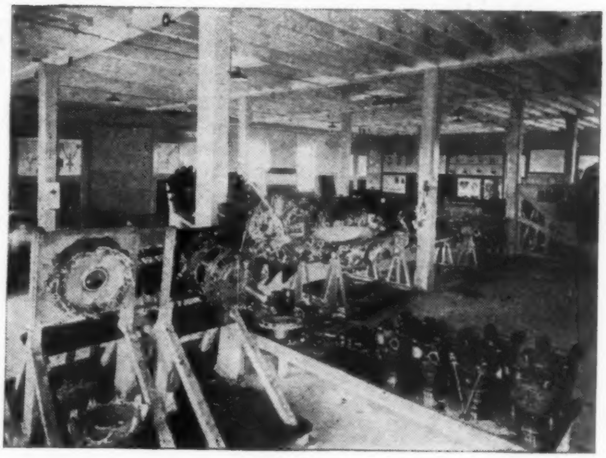
The biggest advantage of this cylinder is that it can be built and secured to the engine individually. If one needs changing, only that one need be removed. It can be done quickly and with very little work.

Water-cooled cylinders are occasionally made in blocks similar to those used on automobiles. This practice has met with little favor of late, however, and most of the cylinders are built up from a steel sleeve in which the piston slides. Around this sleeve is usually screwed or welded an aluminum or steel jacket which provides a path for the circulation of the cooling liquid.

Sometimes the sleeve is screwed in an aluminum block which has space for the cooling water. In this case the liquid does not come in actual contact with the inner steel sleeve. This

is called the "dry sleeve" type of construction. When the water is allowed to come into direct contact with the steel liner it is termed a "wet sleeve" cylinder.

The latter method of cooling is more efficient, for in the former the heat must pass through the joint made between the liner and the jacket. Moreover, the coefficient of expansion of steel and aluminum differ. Accordingly, the jacket will frequently expand away from the liner. This makes a poor contact and the excess heat will not escape.



Above, engine section Naval Air Station ground school, Pensacola, Fla. Packard 2-A 150 Inverted engine (below)

The combustion space is the volume between the piston and the cylinder head. The ideal shape of this space is spherical for then the least amount of wall surface would come into contact with the gases of combustion. Hence, less heat would be radiated and lost through the cylinder walls.

For reasons of strength and cooling, however, this ideal shape is impractical. A compromise is made and the combustion space of the air-cooled cylinder is generally formed in approximately a truncated cone. This permits the use of valves of sufficient size.

Obviously, if valves were placed in the top of a flat combustion space, they would be limited in size by the diameter of the cylinder. From general practice we know that these valves would not be large enough to allow a good intake or a good exhaust of gases. The alternative of this is to use two valves each for intake and exhaust.

There is much to be said in favor of the four valve method of construction. The forces of inertia are not so great and having smaller areas they are not so apt to warp from uneven cooling.

The valves of an engine undergo severe usage. Especially is this true of the exhaust valve. The intake valve is cooled considerably by the inrushing fuel. They must stand up under the constant heat of combustion from which there is no relief. To withstand this, various alloys of high grade steel are used. Tungsten, nickel, cobalt, and silicon are used to alloy the steel.

The temperature of the exhaust valve should be kept down to 1,200 F. Various ingenious methods have been devised to cool this member of the engine. The valve stem is frequently drilled hollow, filled with mercury, and then plugged up.

As the valve stem heats up, the mercury at the lower end gets hotter thus causing it to vaporize. The vapor is then condensed in the cool end and so radiates heat to the valve-stem guide. Other manufacturers use a metallic salt in place of mercury. Here the heat is transmitted directly through the fused salts. A mixture of sodium, potassium, and lithium nitrates are generally used for this purpose.

If liquids are used in the hollow valve stem for cooling purposes, the pressure created by the heat tends to blow out the plug end.

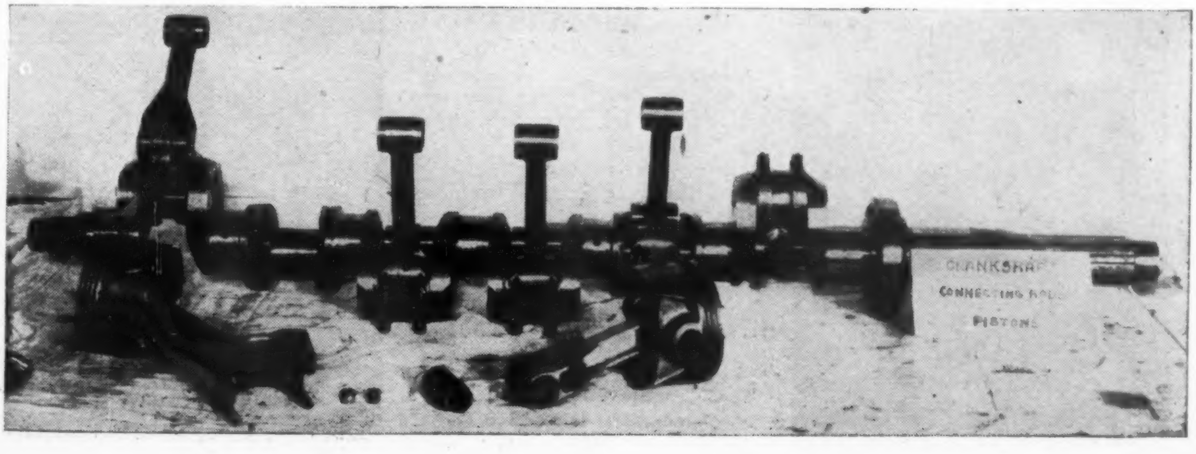
The types of valves most generally used are the tulip and the mushroom. Of these the tulip has practically replaced the latter because it is stronger and resists warping better. Moreover, it streamlines the passage of the gas flow and therefore offers less resistance to the entrance and exit of gases in the cylinder. The valves are made of very hard alloy steel. The most satisfactory designs include tungsten, nickel, and silicon in their composition.

In an in-line, Vee, or "W" type of engine the valves are actuated by an overhead camshaft which is driven by the crankshaft through various combinations of tower gears. On the camshaft is machined lobes at designed intervals. These lobes push the valves open at the proper instant in the engine operation and permit them to close again when their function has been completed.

Provisions are made in the gearing to permit the uncoupling of the camshaft and the crankshaft. In this way the opening of the valves can be properly timed to the action of the cylinder.

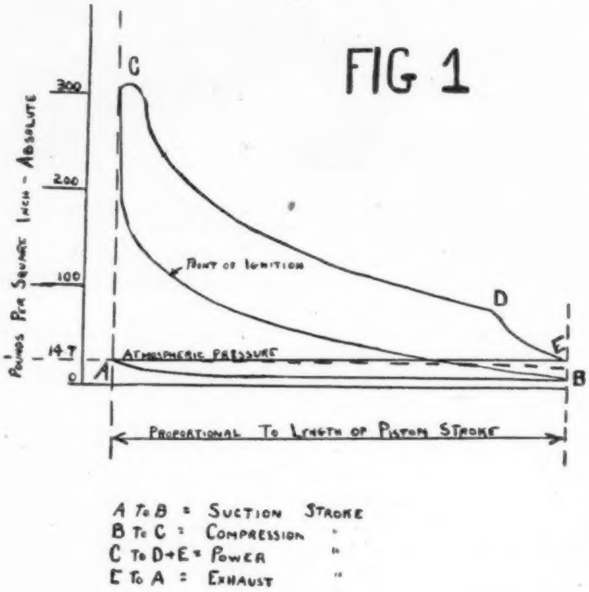
Push rods and rocker arms are

The Mechanical System of the Airplane Engine



necessary to actuate the valves in the radial type of engine. A small roller known as a cam follower is mounted on the inside or lower end of the push rod. This roller rides on a cam disc which revolves with the crankshaft. On this disc are forged high spots, or lobes of a cam. As the roller rides up over one of these lobes it moves the push rod upward.

This motion is in turn transmitted through the rocker arm and thence to the valve which is opened. One disc opens the exhaust valves while a second one operates the intake valves. Through a serrated coupling provisions are made for disconnecting the cam disc from the crankshaft in order that it can be set in proper relation with the cylinder operation.



The valves of an airplane engine always open into the cylinder. That is, when the cylinder is under the pressure of compression or combustion, this pressure aids in making a tight seal. The valves are held closed by means of a helical spring. Thus, a valve may be opened only against the tension of the spring. Two concentric springs may be used for one valve, while the Packard engine uses a nest of small springs for this purpose.

The piston is one of the hardest working parts of an engine. It must not only withstand the terrific heat of combustion of the charge of fuel, but it must transmit the tremendous pressure of the explosion to the crankshaft. A strong and light material is needed in this important position.

In addition, it must be so designed that it will carry away the heat which would otherwise reduce it to plastic material. Aluminum alloy answers the purpose very well. An attempt has been made to use an alloy of magnesium in order to further reduce the weight, but these experiments have not been altogether successful.

The importance of weight reduction can be easily seen when one considers how fast the piston moves. At each end of its travel it must stop and reverse its direction. The forces of inertia are enormous and at one time the speed at which an airplane engine would turn up was limited by the fact that heavy cast-iron pistons were used.

Another function of the piston is to seal the combustion chamber against loss of the explosion pressure. To do this, three cast iron piston rings are placed in grooves machined in the top of the piston. These rings are expanded in various ways so that they press outward and so completely seal the clearance between the piston and the cylinder walls.

A special oil ring is provided at the base of the piston. It is the task of this carefully designed ring to prevent lubricating oil from creeping up the cylinder walls and on into the combustion space.

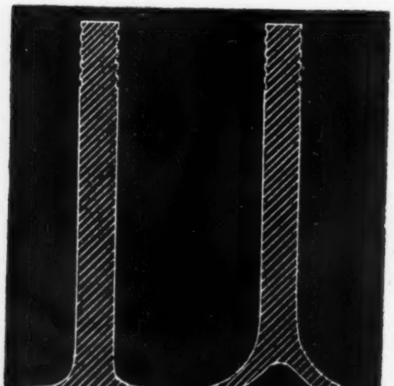
Of course, as these rings wear out they will allow the entrance of lubricating oil into the combustion space and this will invariably result in an accumulation of carbon on top of the piston. Moreover, it greatly increases the oil consumption of the engine. Since provisions are made for only a limited supply of lubricating oil in the modern place, a forced landing may result if too much oil is burned.

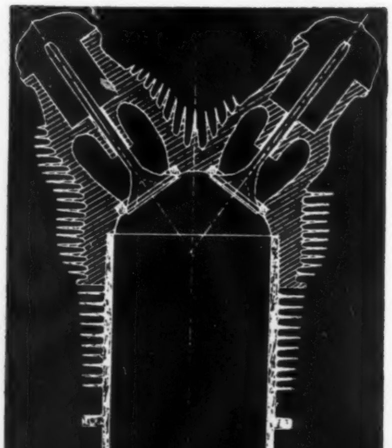
The piston is secured to the connecting rod by means of a small, steel wrist pin. As there is a certain amount of oscillitory motion between the connecting rod and the piston, the wrist pin must have a floating fit; that is, be free to revolve. Otherwise it would soon be worn out of its true shape. However, to prevent it from projecting out from the piston where it would score the cylinder walls, aluminum plugs are locked at each end.

CONNECTING rods provide the means of transmitting the vertical power of the piston to the rotary motion of the crankshaft. As it applies this force at an angle, it is required to be unusually strong in order to resist the severe bending moment. For this reason they are generally constructed of alloy steel, although forged duralium has been used with some degree of success. Greater strength is to be had if the connecting rod is made circular in shape. However, this form is difficult to inspect thoroughly so the latest practice favors the "I" shape.

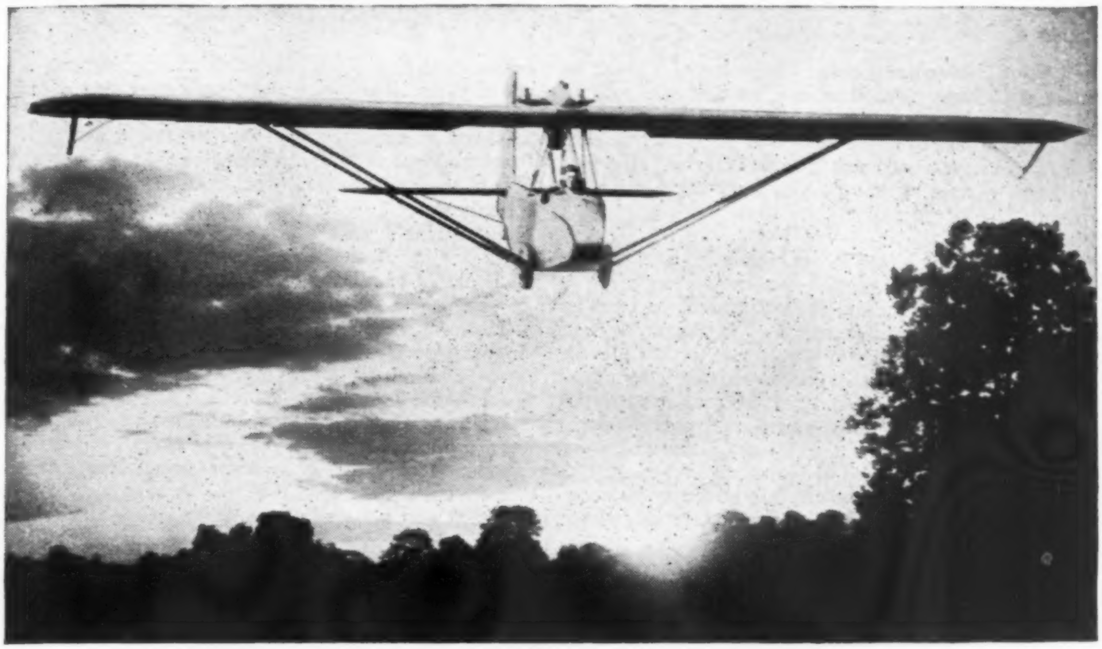
We have seen that the upper end of the rod is secured to the piston by means of the wrist pin. The lower end is often made in two parts which are bolted around one of the cranks

(*Continued on page* 38)





Two principal valve shapes (left)
Pratt Whitney "Wasp" air-cooled cylinder (right)



A motor glider in flight—Motor Gliders, Inc.

GLIDING AND SOARING

By

Percival and Mat White

Final Instalment of this Great Series

WHEN the glider is assembled, when all the angles are as correct as they can be made by measuring and viewing them, and when all the wires have an approximately equal tension, the ship should be tested out in actual flight. Such tests are best made by an expert pilot.

Before taking off, the glider should be balanced on the skid on level ground, with the pilot in the cockpit. If the construction has been properly carried out, the ship should balance exactly on the center of pressure of the wing. Every standard airfoil has been tried out in wind tunnels and the center of pressure determined. The specifications published by the National Advisory Committee for Aeronautics give figures for the enlargement of the various wing profiles, and show the position of the center of pressure of each wing.

You can determine the point on the fuselage on which the ship should balance by drawing a line perpendicular to the chord of the wing from the center of pressure. If the ship does not balance on this point in the fuselage, do not fly it until you have corrected the balance. This should be done by changing the position of the wings, or by some other means, and such changes should be made under the direction of an expert.

Lieut. J. Thoret, center, famous Alps airman

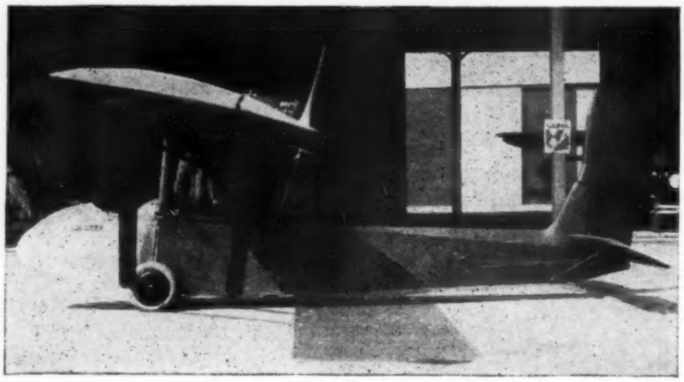
Launching for the test flights should be done by the shock-cord method. It would be dangerous to tow the ship into the air without knowing whether or not it is airworthy. When an able pilot has made several test flights in the glider, he can tell whether the wings are lined up properly, whether the control wires should be adjusted further, etc. Sometimes it may be necessary to change slightly the angle of incidence of the stabilizer. In this event, its angle may be varied by the insertion of a wooden wedge of the proper thickness.

Repairs. As soon as you begin to use the glider, you must expect that it may at any time need repairs. The firmest glider structure is apt to be injured by the shock of a bad landing. Primarily training gliders are usually built so that they can be readily taken apart, and the damaged parts replaced by new ones.

The best way to assure yourself of the use of a glider at any time is to have more than one, so that you can fly one ship while the other is being repaired. For this reason, it is a good idea to begin to plan to build another ship as soon as you have experimented sufficiently with the first one to know exactly what type you want next and what improvements you want to make.

YOU can keep the glider in better shape if you are able to effect a few minor repairs yourself. Therefore, you should keep a kit containing the most useful tools in an accessible place. A work bench in the hangar is most convenient. Besides tools, you should also have a number of spare parts. If you have purchased the glider, these parts can usually be obtained from the manufacturer; if you have built your own ship, you should provide duplicates of several of the parts. The extra parts which you will probably have most need of are an undercarriage (for a primary training glider, a whole box skid may be necessary), a starting hook, and, for the primary training glider, a rudder bar and seat. An extra shock cord may be used to lengthen the old one in order to launch accomplished pilots at a greater velocity.

A few minor parts may be replaced and small repairs made by any one who has built a ship. Slight breakages in wooden fuselages can be mended by cabinet-makers. But only an experienced aircraft builder will be able to tell whether a damaged wing can be repaired, or whether an entirely new wing must be used. Metal construction is very difficult to replace, and an injured metal wing or fuselage should, if practicable, be examined by the original builder of the ship.



A glider with an auxiliary engine—Motor Gliders, Inc.

Overhauling. In addition to the inspection which the glider must be given before each flight, the ship should have periodic examinations by some competent person. The guy wires may relax after a period of hard usage, so that they no longer have sufficient tension. A few poor landings are apt to cause the glue at certain joints to crack; in this event, these joints must be reinforced, so that additional strain will not be transmitted to the remaining joints.

Weakness of the joints will be made evident by the general looseness of the whole structure. An expert, on inspection, is usually able to detect any such defects, and to prescribe the necessary reinforcements and alterations. Only in this way can the possibility of accident be prevented.

Conclusion. While continual reference is made to the expert with whom you should be in consultation, in time, of course, you will yourself become experienced, at least to a certain degree. If you have worked over every part of the ship yourself in building it, you will certainly know how to make certain repairs. Experience and training, however, are essential for this.

The gliding of motored planes is a science which offers many possibilities, although so far it has been little developed. Lieut. J. Thoret, a Frenchman, is said to have been one of the first pilots to make an extended glide in a motored plane. He remained in the air with the motor shut off for more than 9 hours, and this in a plane of old-fashioned design. Following this accomplishment, a number of pilots all over the world have succeeded in imitating him.

Thoret was not the first pilot to glide a motored plane. Several Germans attempted it before him. The most notable of these was Botsch, who, in 1925, made a long flight on only about 2 gallons of gasoline; he did this by deliberately soaring his ship as much as possible. He won a prize for the least consumption of fuel, in competition with planes of all classes. His ship had a 14-horsepower engine.

However, Lieutenant Thoret's gliding flight was the first one of great significance.

Importance of the fact that Motored Planes Can Glide. To be sure, Lieutenant Thoret's flight may seem to have taken away a good deal of the romance which had formerly been connected with soaring. The experiment proved that perfection of design is no more essential to soaring than the strength and duration of the upward air currents and the skill and patience of the pilot. Cumbersome, imperfectly streamlined airplanes and float seaplanes have been soared.

The fact that motored planes can be flown like gliders has a double significance to aviation. In the first place, an airplane which can glide efficiently has the advantages of a glider which is fitted with an auxiliary engine without its chief disadvantage: As long as the motored plane can glide wherever upward currents of sufficient strength are available, it can spare its engine and conserve its fuel; yet, unlike the soarer with an auxiliary engine, the airplane is adapted in construction and design for motored flight.

Except if equipped with a self-starter, a pilot would only soar with a "dead stick" if within gliding distance of a landing field. Still more significant is the fact that the proved ability to keep a ship aloft without use of the engine makes it possible to venture into some regions that provide no landing fields and thus are very dangerous for ships dependent on a possibly failing engine.

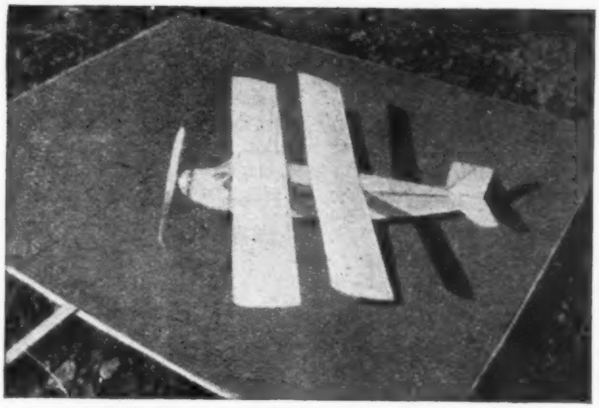
BY repeating experimental flights in a motored plane with the engine shut off, Lieutenant Thoret became so familiar with the varieties of air currents produced by the various configurations in the landscape, that he is now able to take a number of passengers at a time over regions in the Alps which they would not otherwise be able to see. It is possible that clouds and storms may some day become as comparatively safe for motored planes as for gliders.

Advantages of the Light Airplane over the Glider. Since it can be soared in the same way (although not so efficiently) as the glider, the light airplane has some advantages over its motorless parent. It is more solidly constructed, can take off under its own power, can gain height even where there are no upward currents, and is not obliged to land at whatever point the wind may leave it. However, the light airplane is not a glider, and is, in most cases, not comparable with it.

How to Glide in a Motored Plane. Of course, any plane will glide downward in still air; but the airplane's angle of glide is so steep that gliding in still air is of little value except as an approach for a (*Continued on page 35*)

How to Build a

TANDEM FLYING MODEL



The completed model

By Prof. T. N. de Bobrovsky

Something Unusual With Great Endurance Qualities

THIS is an unusual type of tandem airplane, but its endurance qualities will surprise you. On all known tandems the rear wing is placed far from the front wing, but on this model, the rear wing is a short distance behind the front wing. On the usual type of tandem, the angle of attack of the front wing is greater than the rear, but on this type, we find, that the front wing is set at 0 degrees, and the rear is set at + 6°. Figure I, if carefully studied, shows that the dihedral for the front wing is 0 degrees, and for the rear wing 4 degrees.

The special arrangement of this tandem is the patent of Mr. Anthony Lanzetta. New York University and the Aeronautical Research Laboratory conducted numerous wind tunnel tests for the inventor. The flying model shown in the picture, was built after these tests, and was made by Frank Celauro, a High School student in the shop of the A. R. L.

A few interesting facts about the history of tandems might be of interest. The originators of the tandem were Professors Langley and Montgomery, the latter used it for gliding purposes only. The results of these experiments are well known to all American boys. In 1907, the second flying model contest in Paris, was won with a tandem model by Paulhan. Following this, numerous large types of tandems were built in France. Bleriot, Kapferer, Farman, Gabardini and many others built tandem airplanes. The results of these experiments were poor.

From 1910 to 1920 no remarkable advances were made with tandems. After this period Caproni (Italy) made an unsuccessful attempt, with a large sized tandem (capacity 100 persons).

Peyret, a native of France, who was the winner in the first airplane model contest in the world (1905), made a successful tandem glider in 1921, which was the first glider in the world to fly 4 hours without a motor. In 1926 he also built a 2-place tandem with motor.

All these types of tandem planes were similar to the Langley type and all builders encountered great difficulty in trying to make the fuselage strong enough. All known advantages of tandems are annulled when the distance between the two wings gives such high moments that a normally stressed fuselage is unable to withstand the strain. For instance, the Caproni tandem broke in two while in the air.

In the Lanzetta tandem you are about to build, this disadvantage has been overcome, without the advantages being touched in any way.

As a flying model, the Lanzetta tandem shows remarkable stability, re-

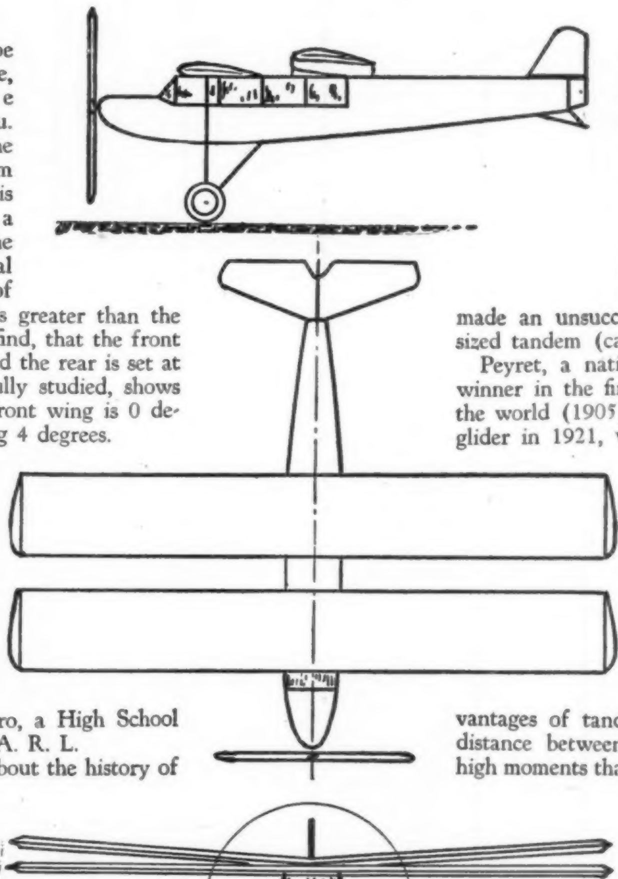
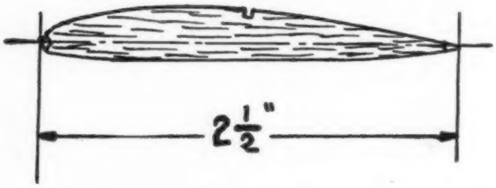


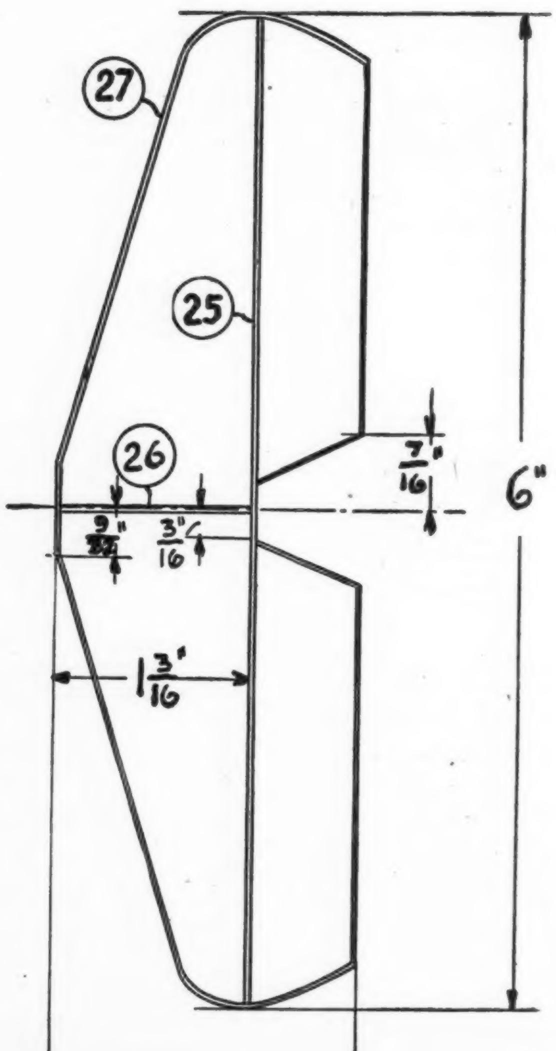
Figure 1.

quires little power, is spin proof and has good landing qualities.

Figure II shows the side elevation and Figure III the top view of the fuselage. From 1/16" thick medium balsa sheet cut out the bulkheads (I-IV) as shown in drawings. Take four 1/16" square balsa strips and glue together with the bulkheads as shown in both figures. These longerons are indicated by the figures **1** and **2**. The bulkheads must be glued to the top longerons first.

After this form the cabin and cockpit windows and the fuselage brace **3, 4, 5,** with 1/32" balsa strips. For **3** use 2 pieces, **4** use four pieces (*Continued on page* 40)





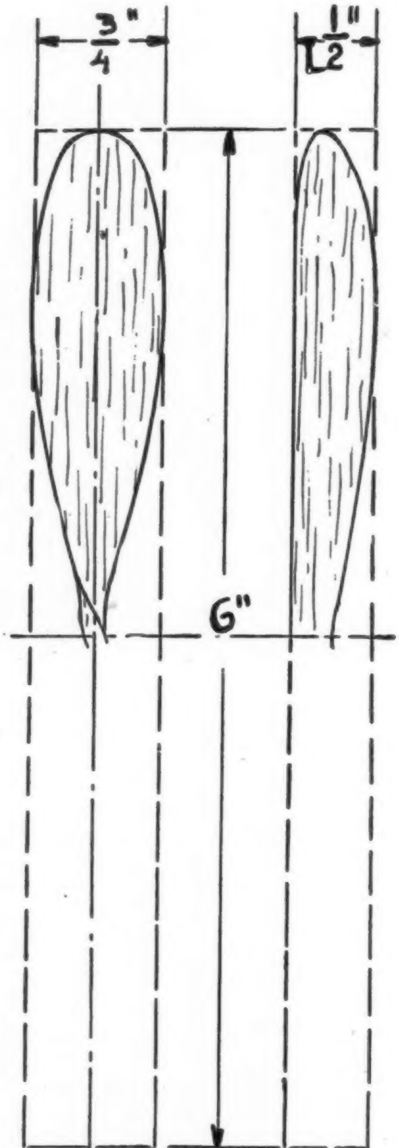
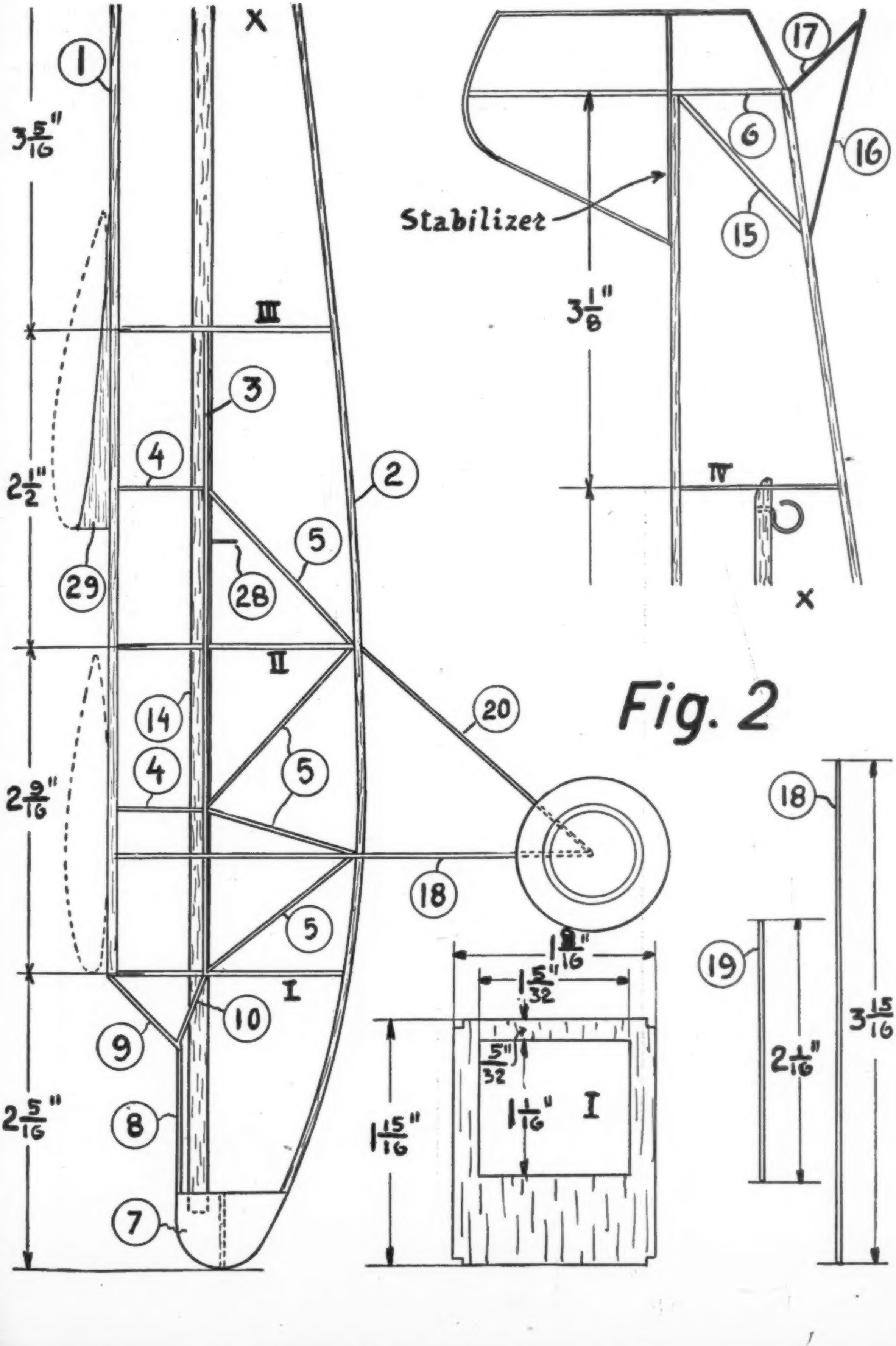


Fig. 5


X
Stabilizer
3 5/16"
2 1/2"
2 9/16"
2 5/16"
3 1/8"
III
II
I
IV
I
1 5/32"
5/32"
1 1/16"
1 15/16"
2 1/16"
3 15/16
1
2
3
4
5
6
7
8
9
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14
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28
29

Fig. 2

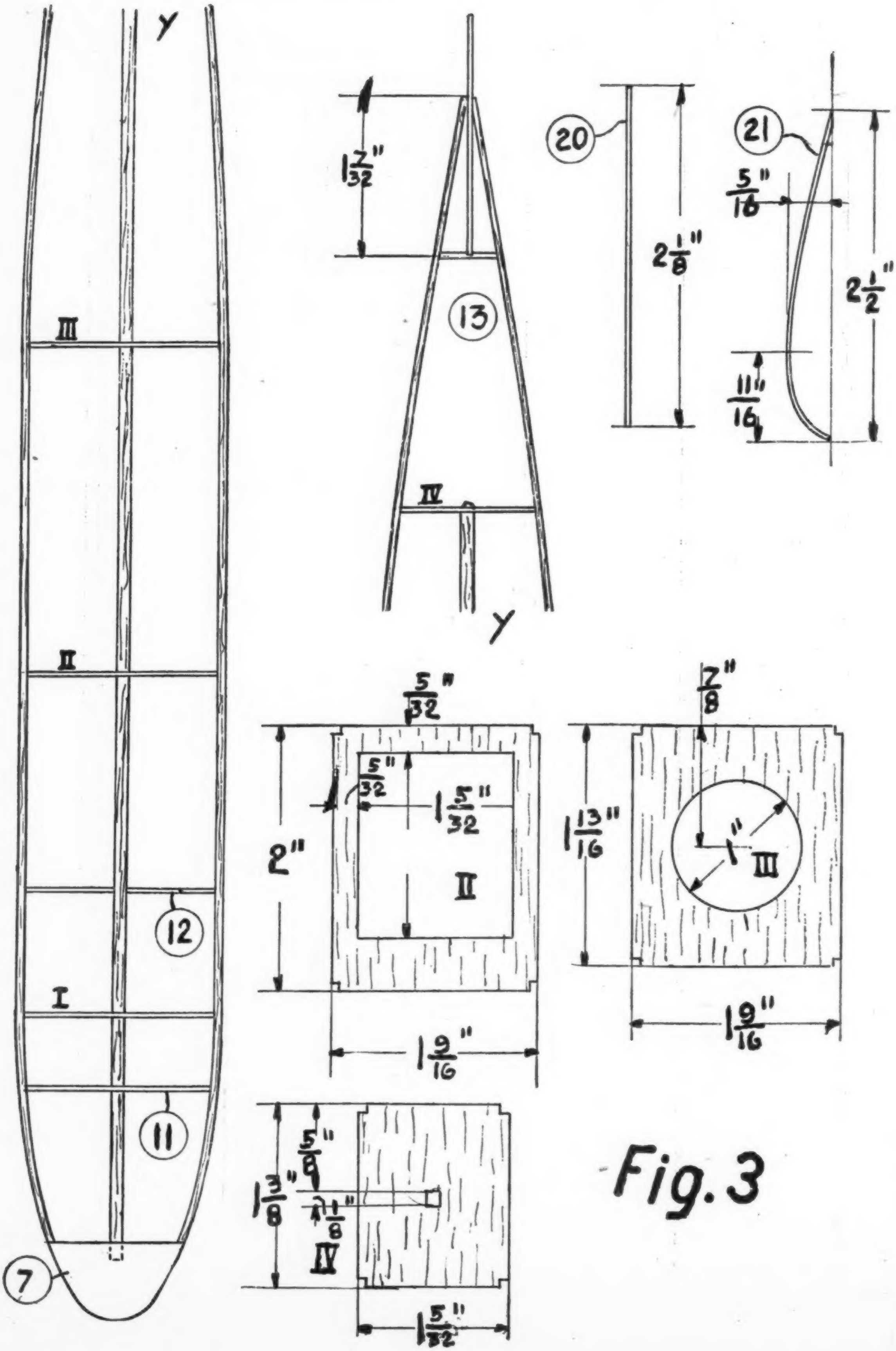
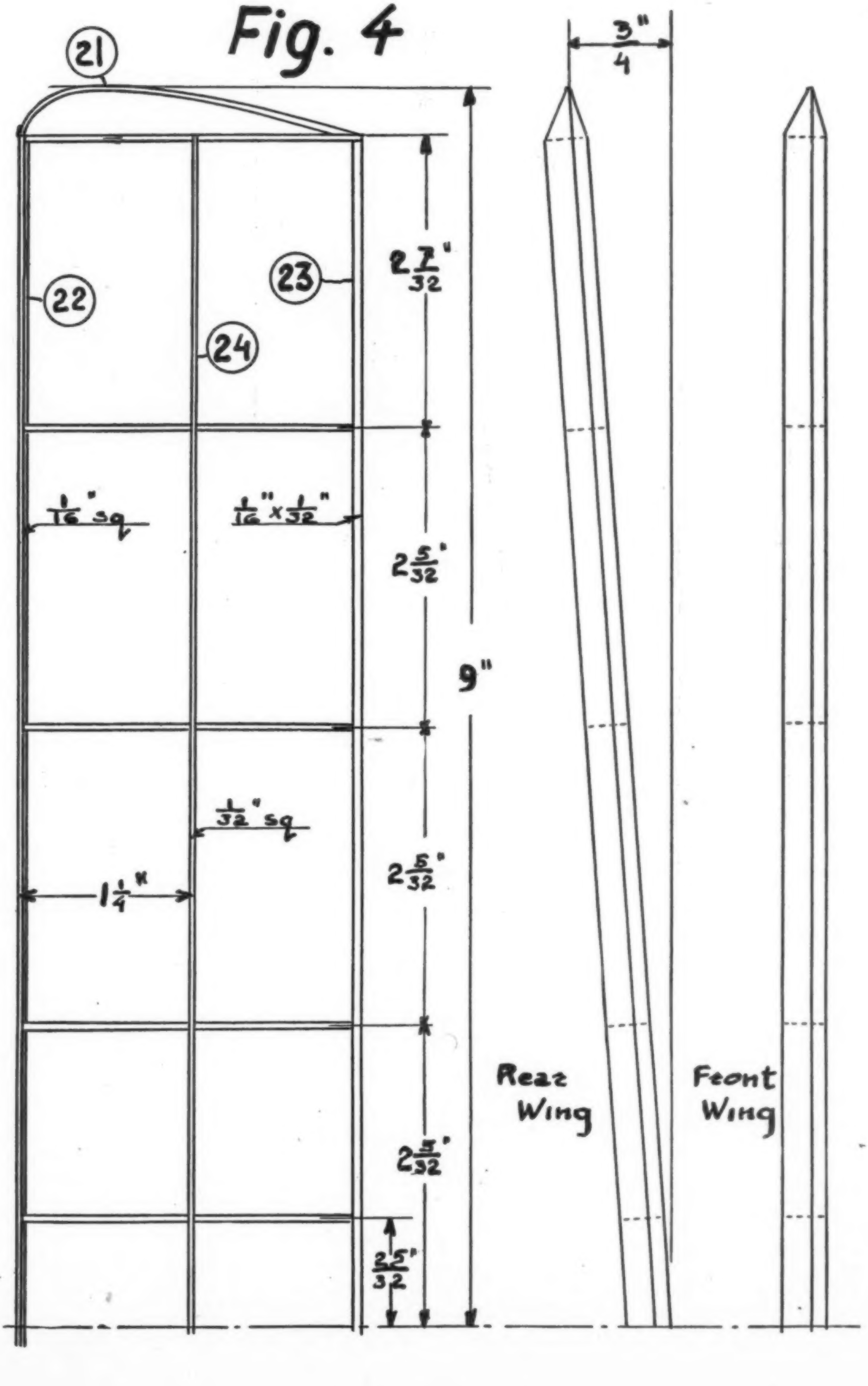

Y
III
II
12
I
11
7
1 7/32"
13
IV
Y
20
2 1/8"
21
5/16"
2 1/2"
11/16"
5/32"
5/32"
1 5/32"
2"
II
1 9/16"
7/8"
1 13/16"
1"
III
1 9/16"
5/8"
1 3/8"
1/8"
IV
1 5/32"

Fig. 3

Fig. 4


21
22
23
24
2 7/32"
2 5/32"
2 5/32"
2 5/32"
25/32"
9"
1/16" sq
1/16" x 1/32"
1/32" sq
1 1/4"
3/4"
Rear Wing
Front Wing

Rene Fonck, of France

By
B. D. KNEEN

So masterful was he at maneuvering that he forced down his enemy without firing a shot!

"MOST perfect air duelist of the Great War." That was Rene Fonck. The Armistice left him as top ace of the Allies, and his official record of seventy-five victories is only five less than von Richthofen's total. However, Fonck brought down fifty-one more that for one reason or another could not be witnessed as required to be made official. His grand total of one hundred and twenty-six is accepted by all war pilots who knew him, and puts him in a class by himself.

Thus on one vivid day he brought down six enemies in two hours—probably the greatest single feat in aerial warfare. With such records as he made, it seems incredible that he never received a bullet in any part of his plane—not even through a wing—and was never wounded himself. Once, before he began combat work, he was brought down by Germany artillery fire while taking aerial photographs and directing artillery fire. His plane was riddled. However, as soon as he became a *chasse* pilot he dodged every bullet, "Archie" and "flaming onion," the Germans could fire at him. And that was plenty.

Fonck was born at Saulcy-sur-Meurthe, in the Vosges mountains, on March 27, 1894. About to be examined for a mechanical engineering course, he became interested in flying, decided to become a pilot, and had just taken his first flight in a Bleriot machine when war was declared.

Called to the colors, he trained in the Aviation Corps and on June 15, 1916, went to Escadrille C.47 at the front. He was cited for his hazardous flights in which, with Georges Wiest, sub-lieutenant observer, he located enemy batteries. Terrific firing from the ground riddled their machine, but they landed safely and kept up their death-defying work.

In 1917, while effecting the first laiason between an airplane and infantry, German ground fire brought him down but he escaped. Sent to the Oise, for seven months the Escadrille C.47 fought through combat after combat. Here Fonck perfected his air-fighting tactics and became an acknowledged master.

His citation for the Military Medal, dated August 6, 1916, reveals his astonishing ability and superiority in aerial combat. It reads:

"*Fonck, Rene Paul. Adjutant pilot of Escadrille* C.47. *Remarkable pilot, brave, skilful and alert, having already taken part in a large number of aerial battles. August 6, 1916, he resolutely attacked two enemy aeroplanes strongly armed. He gave chase to one and by a series of bold and skilful maneuvers compelled it to come down intact within our lines. (Already twice cited in orders).*"

The amazing part of his feat is only hinted at. Fonck forced down his enemy without firing a shot! So masterful was he at maneuvering that he kept the German plane at all times in positions where the enemy gunner could not bring a gun into play, and in addition, the enemy had to continually dodge Fonck while he lost altitude before the Frenchman. The plane, a Rumpler of the latest model, was a two-seater, and landed without injury. It was flown by the Allies and proved very useful.

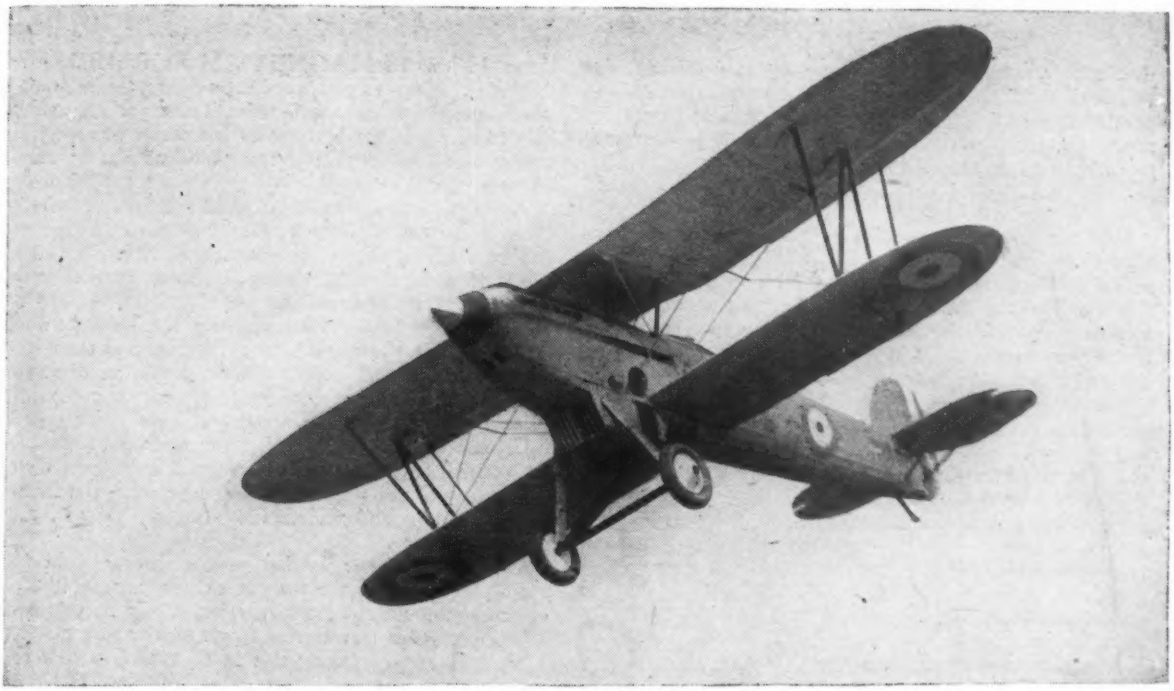
The captured observer was furious—he carried in his pocket a *permission* to go on leave that very afternoon: The crestfallen pilot admitted that he could do nothing but land.

On the Somme sector, fighting with the British, he was still on artillery observation and other special work. While taking photographs on March 17, 1917, a German squadron dived to attack. The old and slow photography planes could not maneuver so effectively, but Fonck, in fifteen minutes, sent one enemy down in flames, and put the rest to flight.

FONCK was at once put into combat work with a fast Spad. Already he had earned four citations, the Military Medal, and a British decoration, and had been promoted to Chief Adjutant. He was then only 23 years old.

He began his real fighting career on May 1, 1917. He won his rank as "Ace," with five planes, in just twelve days! In August he shot down three in three days running. Such rapid victories were outstanding—but he was to far exceed this "output." In the fall of 1917, when he was named Chevalier of the Legion of Honor, he had eighteen victories.

On September 14, 1917, Fonck not only brought down his enemy but carried home the German's barograph as proof. The barograph registered a long flight that ranged far up into the clouds—20,000 feet above ground. Here it was that Fonck attacked! (*Continued on page* 42)



A British Fairey 3F Biplane

Special Course in Aerial Radio

By Capt. Leslie S. Potter

LAST month we mentioned that the flow of an electric current is measured in amperes, and the pressure in volts. We now come to a third quality known as resistance.

Any conductor is bound to offer a certain amount of resistance to the current passing along it. Resistance is the amount of opposition offered by a conductor to the current passing along it. A water pipe will offer a certain amount of resistance to the water passing inside it; if it is bent, the resistance will be greater. A narrow-diameter pipe will offer a larger resistance than a pipe of wider diameter.

So it is with electricity. A larger wire will permit a greater flow of current than a smaller wire. A wire that has been coiled or distorted will offer a larger resistance than a direct line.

The measurement of resistance is made in ohms, named after a German who discovered the law; and the relationship between amperes, volts and ohms is known as Ohm's Law. Since this relationship is important in electrical matters, it should be committed to memory.

In the following formulae E (for electromotive force) stands for volt, and I represents amperes. In earlier days a current used to be referred to by its intensity, and the symbol I, which was used then, still remains today. The symbol R (for resistance) is used for ohms.

$$\frac{E}{R} = I \text{ or } \frac{\text{Volts}}{\text{Ohms}} = \text{Amperes}$$

If you divide the voltage by the resistance you will get the amperage.

$$\frac{E}{I} = R \text{ or } \frac{\text{Volts}}{\text{Amperes}} = \text{Ohms}$$

Dividing the voltage by the amperage will give the resistance in ohms.

$$R \times I = E \text{ or Ohms x Amperes = Volts.}$$

The resistance multiplied by the amperage will give the volts.

It is possible to obtain a table showing the resistance of different standard sizes of wire.

It is often necessary to use one or more resistance coils in a circuit. When they are placed in sequence as shown in Figure 1, their total resistance may be found by adding the resistance of each individual coil. When, however, they are placed parallel, as in Figure 2, provided the resistance of each coil is the same, the total resistance in ohms divided by the number of coils will give the resistance imposed on the circuit.

In a case where the resistance of three coils placed in parallel varies; where, for example, the three resistances were 2 ohms, 4 ohms and 6 ohms, the combined resistance would have to be found by first calculating the conductance. Conductance is the reciprocal of resistance. In the case quoted, the calculation would be made as follows:

Resistance of Coil 2, 4 ohms = Conductance $\frac{1}{4}$.
Resistance of Coil 1, 2 ohms = Conductance $\frac{1}{2}$.
Resistance of Coil 3, 6 ohms = Conductance $\frac{1}{6}$

$\frac{1}{2} + \frac{1}{4} + \frac{1}{6} = \frac{11}{12}$ Conductance $= \frac{12}{11}$ ohms $= 1.09$ ohms.

The joint resistance of these three coils would, therefore, be 1.09 ohms.

It is easy to understand the reason for these different methods of calculation by taking the water analogy again. If a flow of water were sent through a series of bent pipes one after the other as suggested by the resistance coils in Fig. 1, its flow would be interrupted to a considerably greater extent than if it were divided into three streams so

A Cardinal Point in Progressive Aviation

(Chapter 2)

that each stream would only have to pass through one length of bent pipe as suggested by the resistance coils in parallel in Fig. 2. Electricity is exactly the same, therefore resistance coils placed in series offer a much greater resistance than when placed in parallel.

GENERATORS

We mentioned last month how an electric current was formed by the preservation of a difference of potential between two terminals, and how, for commercial purposes, this was effected either by a battery or generator. The first named was dealt with last month and we now come to the generator from which the main power for practically all transmitting sets is obtained.

Generators are divided into two main classes, direct current generators and alternating current generators. Among radio engineers it has become customary to refer to the first as a dynamo and the second as an alternator. The fact that a generator operates through a driven armature and a magnetic field of its own creation has already been mentioned. The time has now come to consider this statement in detail.

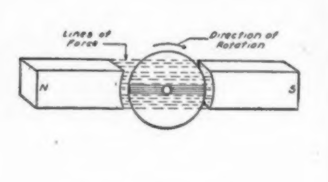


Fig. 6 - Rotating Coil

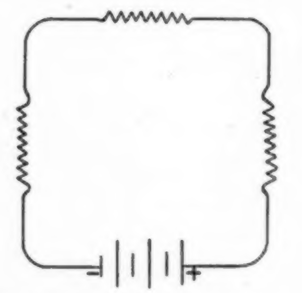


Figure 1 - Resistance Coils in Series

You may, perhaps, wonder what a generator has to do with radio. To be sure, it has nothing to do with the actual transmission, but an operator is expected to understand the fundamentals of a generator. Indeed, 10% of the marks in a commercial radio operators' examination are allocated to motors and generators.

The first point to be appreciated is the influence of magnetism on electric currents and vice versa.

To all intents and purposes, the earth is a vast magnet, and many of the substances in it contain magnetic properties. Certain metals have stronger magnetic properties than others, and it will be seen that if placed in certain positions they will attract each other, while in certain other positions they will repel each other.

In Figure 3 two bar magnets (small strips of magnetized metal), have been placed together. In one position they adhere closely to each other, but if they are separated and an opposite end of one presented to the other, it will be found that they repel each other. This leads to the fact that there are two influences in magnetism named poles, and these are distinguished as red and blue poles. Like poles repel; unlike poles attract.

Another feature that will be noticed is that the magnetism at the end of a bar is far stronger than that in the middle. In Figure 4 a magnet has been placed in a group of iron filings. It will be seen how they have bunched closely together round the extremities, leaving the middle bare.

The magnetic influence of each magnet will have a radius depending on the strength of its magnetism. The area of this influence is called the magnetic field, and through this, lines of force or magnetic flux are continually passing. Figures 5 and 6 illustrate lines of magnetic force.

Magnetism is, therefore, the attractive influence found in certain substances.

HOW IS MAGNETISM FORMED?

In the answer to this question we find the relation between electricity and magnetism. There are natural magnets to be found in the form of loadstone, but most magnetism used commercially is artificially induced by an electric current.

A magnet round which is coiled a length of wire will cause a current of electricity to flow through that wire, and inversely, a bar of non-magnetized iron placed inside a coil of wire, through which an electric current is flowing, will become magnetized.

To prove it, make a circuit with the battery of your pocket flashlamp, place it near a compass and see how the needle is deflected by the magnetic properties of the current; or coil a piece of wire round a piece of iron, connect either end to terminals of a cell and leave it for a period.

On removing it later the iron will be found to be highly magnetized, and an electro-magnet will have been formed. The extent of the magnetism will depend on the intensity of the current, and will diminish rapidly as soon as the current ceases.

With the current flowing in the direction shown in Fig. 7, the poles of the magnet will be as indicated. By reversing the current the magnetism would be destroyed.

The process of transferring magnetism from a magnet to a piece of metal, making this in turn magnetic, is called magnetic induction, and, as has been seen, it works both ways—from magnetism to electric current and from electric current to magnetism.

Since two substances do not have to be placed in direct contact in order to induce magnetism from one to the other, it is established that magnetism entering one must be induced from the other along the lines of magnetic force.

Next in the sequence of discoveries that led to the generator was one by Faraday, who found that by rotating a copper disc in the magnetic field created by a single horse-shoe magnet, and making an indirect or secondary circuit with the copper disc, an electric current was induced into the circuit that varied with the speed with which the disc was revolved. When it was left motionless, no current was induced.

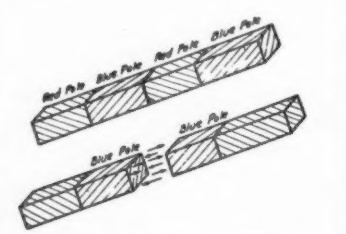


Fig. 3 Magnetic Attraction

Following this, it was discovered that the same result was obtained if the magnet was rotated inside a solenoid. A solenoid is the name given to a coil of wire through which a current is passing. The same coil is called a helix if no current is passed through it.

These discoveries were important for they established the fact that since no part of the turning copper disc or rotating magnet were in direct connection with the secondary circuit into which the current was being induced, this must have been created by the continuous cutting of the magnetic lines of force.

By substituting and rotating a coil of wire in place of the copper disc, and making an indirect connection between this and a secondary circuit, precisely the same electric current was induced into the secondary circuit as

before. Positive and negative ends of a circuit were determined by the direction in which the coil was rotated.

ARMATURE

This coil of wire is known today as the armature, and the poles of the magnet are called the field poles. There may be several field poles in a generator.

Here we have outlined the fundamental principles of the present day generator; an armature rotated by mechanical means through a magnetic field of its own creation, inducing an electric current into a secondary circuit.

ALTERNATING GENERATOR

It has just been remarked that so long as the copper disc was turned continuously in the same direction, the positive and negative terminals of a secondary circuit would remain the same. If direction of rotation is reversed, position of terminals in relation to each other is also reversed.

A moment's reflection will explain the significance of this. What does the reversing of the terminals mean? Since an electric current flows from negative to positive, the reversal of the position of the terminals means in effect the reversal of direction of the current flow.

By rotating the copper disc, then, in an opposite direction, or *by cutting the lines of magnetic force in an opposite direction,* a reversal of current is obtained.

Substituting an armature, or coil, for the copper disc, and instead of changing the direction of its rotation, revolving it between two magnets of opposite polarity, will cause the same reversal of current to take place.

Referring to Figure 8, it will be seen that the coils in the loop are in a horizontal position to the lines of force. In this position a maximum electromagnetic force is obtained. When the loop has performed a further quarter revolution, the coils will be at an angle of 90 degrees to the lines of force and a zero current will be generated.

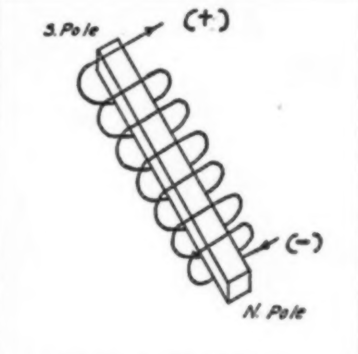


FIG. 7 - ELECTRO - MAGNET

Continuing the revolution another 90 degrees, the coils and lines of magnetic force lie once more parallel to each other; only this time, the magnetic field, being cut in an opposite direction to the way it was cut during the first half of the cycle, the E.M.F. generated will flow in an opposite direction.

DURING each complete revolution of the armature there are two alternations. The complete revolution is called a cycle, and the number of cycles per second is called the frequency.

When the coils lie parallel to the lines of force and a maximum voltage obtained, the current is said to reach a maximum amplitude.

These are the fundamentals of an alternating current generator. The reader should again remember the difference between E.M.F. (voltage), and current. The former is the motive power which impels the latter.

Two rings called collector rings, so named because they collect the current generated and pass it on to the secondary circuit, revolve with the armature. The secondary circuit is connected to two carbon brushes which rest permanently on the rings, and it is through this medium the current is impelled.

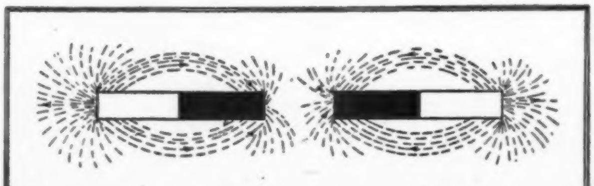


FIG. 6 LINES OF MAGNETIC FORCE WITH LIKE POLES TOGETHER

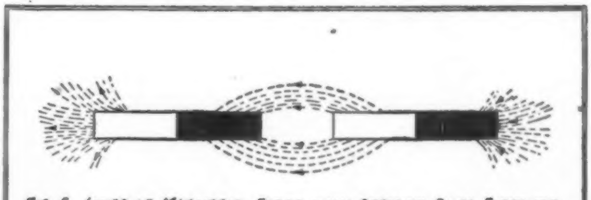


FIG. 5 LINES OF MAGNETIC FORCE WITH OPPOSITE POLES TOGETHER

THE voltage generated will depend on the strength of the magnetic field; the size of the armature, that is to say, the number of turns of wire it contains; and also the speed with which it revolves.

The maximum voltage of an alternator will obviously be higher than its effective, or average voltage. The effective voltage is found by dividing the maximum voltage by 1.41, and inversely, the maximum voltage may be found by multiplying the effective voltage by 1.41. For example, if the effective voltage as shown by an alternating current meter was 110 v., the maximum voltage would be 110 x 1.41=155 v.

It has just been explained that the voltage generated depends on the strength of the field and the size and speed of the armature. If the strength of the magnetic field is increased, that is to say, if more field poles are used, the speed of the armature may be reduced. This is a fact frequently taken advantage of in modern generators, most of which have several field poles. There are generally as many brushes as poles.

TRANSFORMER

The voltage generated may be stepped up; that is to say, increased by the medium of a transformer. A transformer is composed of two insulated coils of wire called primary and secondary coils, wound in inductive relation to each other, generally round a steel of soft iron core. The type of core used will depend on the purpose for which the transformer is required.

Electrical energy generated is transferred from the primary to the secondary coil and from here passed on to the rest of the circuit.

If the secondary coil has more coils than the primary there will be a step-up transformer; if it has less there will be a step-down transformer. If the primary has 50 coils and the secondary 2,000, the voltage from the first to the second coil would be stepped up 40 times, assuming no energy has been lost elsewhere. This will often happen through the transformer becoming overheated and various methods of cooling are used; water, forced air and oil. In America the air cooled type is mostly used, in Europe oil cooling has become prevalent.

Transformers are of great use to companies distributing electricity over large areas. To conduct a high amperage with a minimum loss of energy, a much heavier copper conductor is needed than to conduct a smaller amperage with a higher voltage, though the same amount of power would be available in each case.

Therefore a company (Continued on page 40)

The American Sky Cadets

Stern's Sky Cadets leaders: left to right, Capt. H. J. Loftus-Price; Capt. Fred Pippig, Mr. Hawley Bowlus and Mr. Ben Shereshaw

IN view of the many letters received each month at the offices of MODEL AIRPLANE NEWS from educators, boys' and other organizations asking for information and assistance in organizing and running model airplane clubs, the following account of the Marquis de Lafayette Junior High School Club at Elizabeth, N. J., might be of some interest.

Through the courtesy of Mr. E. R. O'Brien, principal of the school, an appointment was made with Mr. M. Peake, one of the instructors of the club and also a member of the faculty. Mr. Peake who, in addition to his duties in the school, is also Director of the Curtiss Wright Junior Aviation School, very kindly supplied the necessary data.

Marion Burrill of Providence, R. I.

In April, 1928, Mr. Peake, who had been in the Naval Air Service during the World War, attempted to interest some of the students in the formation of a miniature aircraft club. He strongly emphasized the fact that all the work and the meetings would be outside of school hours. One hundred and sixteen boys, or 40 per cent. of the eligible enrollment, attended the first meeting. The interest manifested was so deep and so purposeful that Mr. E. R. O'Brien took immediate cognizance of the educational value involved and arranged to incorporate the activity into the school curriculum as a part of the regular guidance and club program.

John Bausewein, student at A. R. L.

The club activity program of the school is based upon the principle of student interest, and in September, 1928, when the students selected their clubs for the ensuing school year, it was found that 141 boys, or more than 50 per cent. of the eligible enrollment, had chosen the Air Cadets as their choice. The size of the club made necessary the obtaining of assistance from other faculty members and four instructors who had previous experience or interests in aeronautics volunteered to take charge of certain divisions of the club activities.

The enthusiasm and intelligent activity of members of the Lafayette Air Cadets has had an inspirational effect upon all connected with it. The faculty fully recognize the possibilities of this adolescent boys' organization and are untiring in their efforts to establish high standards of action and accomplishment.

Deeply conscious of the fact that they are dealing with adolescent boys vitally in need of an outlet for pent-up energies, the instructors in charge have felt that the objectives should not be merely those of training for a possible vocation, or of developing "air-mindedness." Rather they feel that the major objectives should be to give a strong incentive to healthy living habits, hence their physical tests; to create new interest in clean reading, and in associated school subjects, hence the ground tests; finally, to create a pride in achievement through official school recognition and through the granting of wings, as well as to provide a basis for intriguing spare-time activity through the model building contests.

The cadets are divided into different squadrons. A cadet captain who has won his wings is in charge of each squadron.

The instruction is carried out under following conditions:

Designing and Construction Division.

I. Kinds of aircraft—comparisons.
  a. Land planes.
  b. Sea planes.
  c. Amphibians.
  d. Airships.
  e. Balloons.

Frank Celauro, student at A. R. L.

II. Construction of aircraft.
a. Aircraft parts; b. Aircraft materials; c. Aircraft design.
III. Model building.
a. Demonstration of model assembly; b. Designing of individual models; c. Construction of models.

Flight and Testing Division.
I. Why planes fly.
A. Demonstration showing the effects of changing. 1. The wing area; 2. The angle of incidence; 3. The positions of movable surfaces; 4. The center of gravity.
B. Air pressure demonstrations.
C. Selected model flights.
II. Testing cadet models for construction defects.
III. Cadet model flight tests.

Radio, Air navigation—meteorological division.
1. Fundamentals of navigation; 2. Navigation instruments—construction and use; 3. Aerology; 4. Aircraft radio—a. Sending and receiving morse code; b. Radio beacons—field localizers. 5. Aerial mapping and photography; 6. Rules of the air.

Each cadet is given a physical test, and ground test covering the work in the four divisions, and a flight test. Those cadets obtaining special distinction receive their wings. This is the highest attainment a cadet can aspire to and the wings are a coveted reward for only 19 boys have been honored with wings in the nearly four years that the club has been in existence.

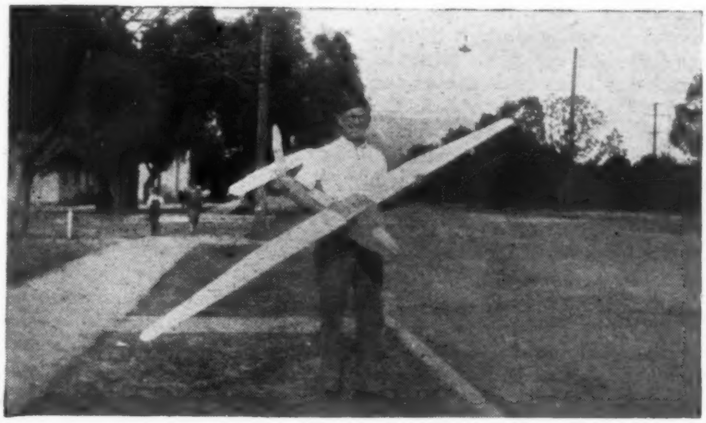
Six questions taken at random from a ground test will give some idea of the ground covered by the course of instructions. The cadet is required to underline the word or the group of words which make the sentence correct.

1. The first flight by man in a heavier than air machine was made by Lindberg, Lilienthal, Wright, Langley, Byrd.
2. An airplane flies because the air-pressure under the wing is less, same, greater, 15 times as much, as the pressure on top of the wing.
3. The terms radial V.X. line refer to propellers, self-starters, engines, pistons, carburetors.
4. In order to gauge airplane performance in advance of construction diagrams are made, aspect ratio is determined, decalage is set, wind tunnel tests are made with models, ailerons are used. *Also*
5. The rudder is used to make the airplane move to—or—while the elevators cause the airplane to move—or —and the ailerons are used in making either a—or a —.
6. The names of three good books or magazines on aviation are — — —.

In addition a diagram of an airplane was given with the different parts numbered, the cadet being required to name the numbered parts.

In reaching its present stage of perfection it might be mentioned, for the information of other schools and boys' organizations, that no special equipment or appropriation have been obtained for the club. All equipment used has been made or obtained by the members. Lectures are given in the different (*Continued on page* 41)

Walter Ebersole of La Verne, Calif., below; in circle, Mr. Samuel Munheim, head of Stern Bros. store



At left, Ian MacTavish, Seaforth, Ont.; center, Bamberger Aero Club members; and at right, Victor M. Pina, Havana, Cuba

Ernst Udet of Germany

By
O. H. KNEEN

He is probably the only pilot who rammed an enemy plane—and lived to tell the tale!

ERNST UDET, who came out of the World War with sixty-two victories, second only to von Richthofen on the German side, was only eighteen when he won his first victory. There was probably no younger war pilot. He had a most remarkable control of his plane at all times, no matter how heated the flight above the clouds, and many were his narrow escapes from death or capture. He is believed to be the first war pilot to save his life by parachute.

Probably Udet's most thrilling experience occurred when he was forced to jump for his life. He had been sent up, shortly before a heavy bombardment, to fight a French plane that had been flying low over the German lines. Suddenly, as Udet started toward the lines from his airdrome, the shells began screaming through the air.

They dug up the earth and their explosions filled the air with "bumps" and smoke as Udet cruised over the battleground looking for the French plane. Above the barrage he pursued his adversary. Finally the Frenchman turned his plane, as Udet began pouring shots into it—and the French machine suddenly banked, and began flying directly into Udet's machine-gun fire!

As the machine passed, the German ace saw the observer's seat vacant. Assuming that he had been killed or wounded, and had fallen to the cockpit floor, Udet dived at the unprotected side of the French plane, shooting hot pellets of death.

Instantly the observer arose, however, and let out a stream of fire that caught the German with the whole burst! Udet's machine was riddled and plunged into a dive that seemed headed for death. All controls were jammed. Udet tugged frantically but in vain, as he plunged headlong toward the leaping earth.

With death staring him in the face, the German ace grabbed his parachute, a crude device carried on the seat as a cushion. The terrific rush of the dive flung him violently back against the cockpit and stunned him. When he tried to jump, his parachute caught on something.

The next moment, when his tumbling plane was hardly a thousand feet from the ground, he managed to fight his way out, though he was dashed against the structure several times. He leaped—the parachute opened—and he landed safely, though slightly stunned.

But when he came to, he found that he had dropped squarely into the middle of a terrific Allied barrage! He kicked loose from the cumbersome silken folds, and ran toward the German lines. Stumbling across craters and hillocks, knocked off his feet, thrown into the air and struck by flying rocks and clods, he was bruised and cut all over. With the blood flowing freely, he kept on and finally dropped behind a ridge upon several astounded German infantrymen. What a place to meet an aviator!

Udet left immediately after the bombardment and a gas attack had passed, got through to a town and sent a call to his squadron. His plane having been reported down in the midst of the barrage, he had a difficult time convincing his mates that he was alive. He was given a great welcome.

Early one morning Udet came upon a French machine just as it was about to shoot down a German from the rear. Dashing to the rescue, with two bursts he sent the French attacker into a spin. However, some distance below, the downed machine straightened out and began to glide toward the French lines. Udet dived after it in an effort to catch it before it could land.

SUDDENLY the French plane veered around and its pilot made a desperate attempt to ram Udet's machine. Having only gliding speed, this attack failed. As he glided by, the Allied pilot shook his fist at the pursuing German. His ramming attempt made him land badly, and the machine rolled over several times, smashing completely.

Udet himself landed, (for this was in German territory) and ran up to the plane. He found that the downed pilot was W. B. Wanamaker, an American flying with the French, and that he was considerably injured in the crash.

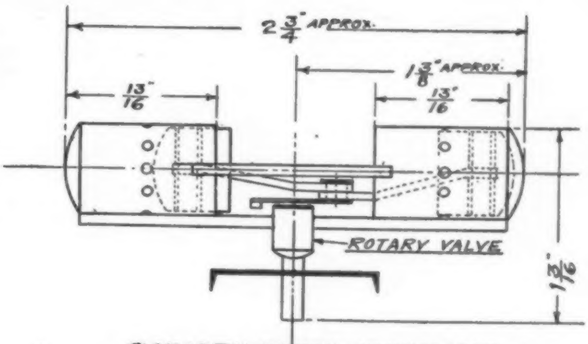
Udet himself is probably the only pilot who won a victory by ramming an enemy plane—and lived to tell the tale. Collisions in midair are nearly always fatal, or were until parachutes came into general use.

He was flying with some escort planes, at about two thousand five hundred feet, on August 8, 1918. Suddenly an English plane swooped down from the sky straight at Udet, who banked and circled till he was above the attacker. The latter then dropped into a steep dive, Udet on his tail. At about one thousand feet the English pilot suddenly Immelmanned, coming (*Continued on page* 39)

A MODEL
COMPRESSED AIR MOTOR

By Major H. W. Landis, E. M. E.

Light, Powerful and Inexpensive

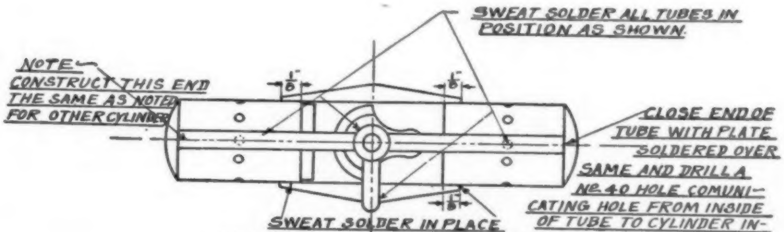


PLAN VIEW GENERAL ARRANGEMENT OF OPPOSED TWO CYLINDER MODEL AIRCRAFT ENGINE.
SKETCH No. 10

MODEL airplane builders have long hoped for a motor other than that of the twisted rubber band variety, which while practical for short flights, does not sustain the tiny craft in the air as long as could be desired.

Engines driven by compressed air are very satisfactory and much in favor as a reliable means of propulsion but, unfortunately, the cost is prohibitive to the average model enthusiast.

Yet a model engine driven by compressed gas is now within the reach of a most modest pocket book and is even more efficient than the higher-priced compressed air engines.

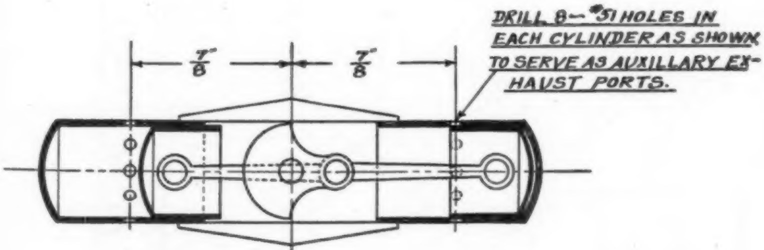


FRONT VIEW GENERAL ARRANGEMENT OF OPPOSED TWO CYLINDER MODEL AIRCRAFT MOTOR
SKETCH No. 7

The Landis model aviation engines are extremely light of weight, yet produce a surprising amount of power. For instance, a two-cylinder engine develops .6 H.P., and produces a speed of 2,000 R.P.M. Approximately two ounces of fuel will keep the model in sustained flight for an hour or more.

No difficulty will be experienced in obtaining the materials for its construction at any hardware or sporting goods store.

This two-cylinder opposed model is worth making because of its inherent light weight due to structural design.



SECTIONAL VIEW—FRONT BEARING REMOVED. OPPOSED TWO CYLINDER MODEL AIRCRAFT ENGINE
SKETCH No. 16.

Cylinders and pistons are formed from fishing rod ferrules easily obtained from any hardware store at slight cost. These ferrules slide one within the other and form a tight sliding fit, the ferrule fitting to the inside to be used as a piston, and the outside ferrule as the cylinder.

These ferrules are seamless drawn brass and are about twelve thousandths-of-an-inch thick, bringing weight to the minimum.

Pistons of small motors must slide very easily within their cylinder. This easy sliding fit is produced by "lapping in" the pistons to the cylinder walls with a thin mixture of "Bon Ami" and water. (Do not use emery or carbonundum powders as the finest qualities of these is much too severe for the very close but easy fit necessary.)

Many very fine valve grinding compounds are on the market but none of these are suited for even the roughest of "lapping" as the coarse abrasives would destroy the fit entirely.

Lap pistons and cylinders as shown in sketch No. 1, using the full length ferrules as obtained, and cut them to proper lengths for piston and cylinder after sliding fit is correct. Cut pistons and cylinders from "lapped in" ferrules with a fine toothed back saw, being very careful not to deform them while doing so.

Remove all burrs and rough edges with a magneto point or nail file and smooth the edges with crocus paper.

Drill the pistons in proper place, as indicated in sketch No. 2, for wrist pins using a 1/8" drill. Make wrist pins from 1/8" thin wall brass tubing.

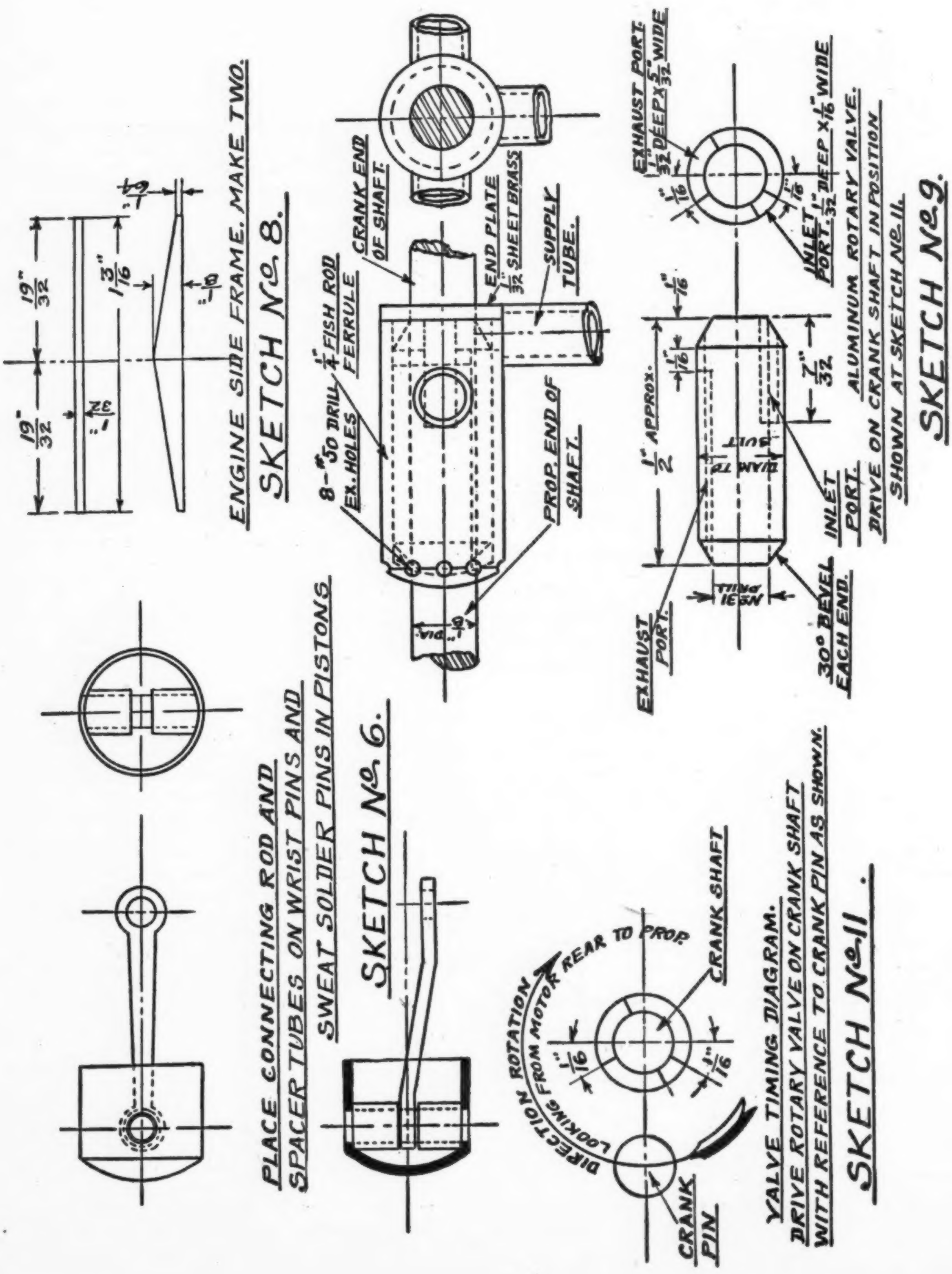
Connecting rods are made from 1/16" sheet duraluminum hard rolled. If duraluminum is unobtainable, aluminum metal can be used which can be obtained from any discarded aluminum cooking utensil. Cut, then offset the rods as indicated in sketch

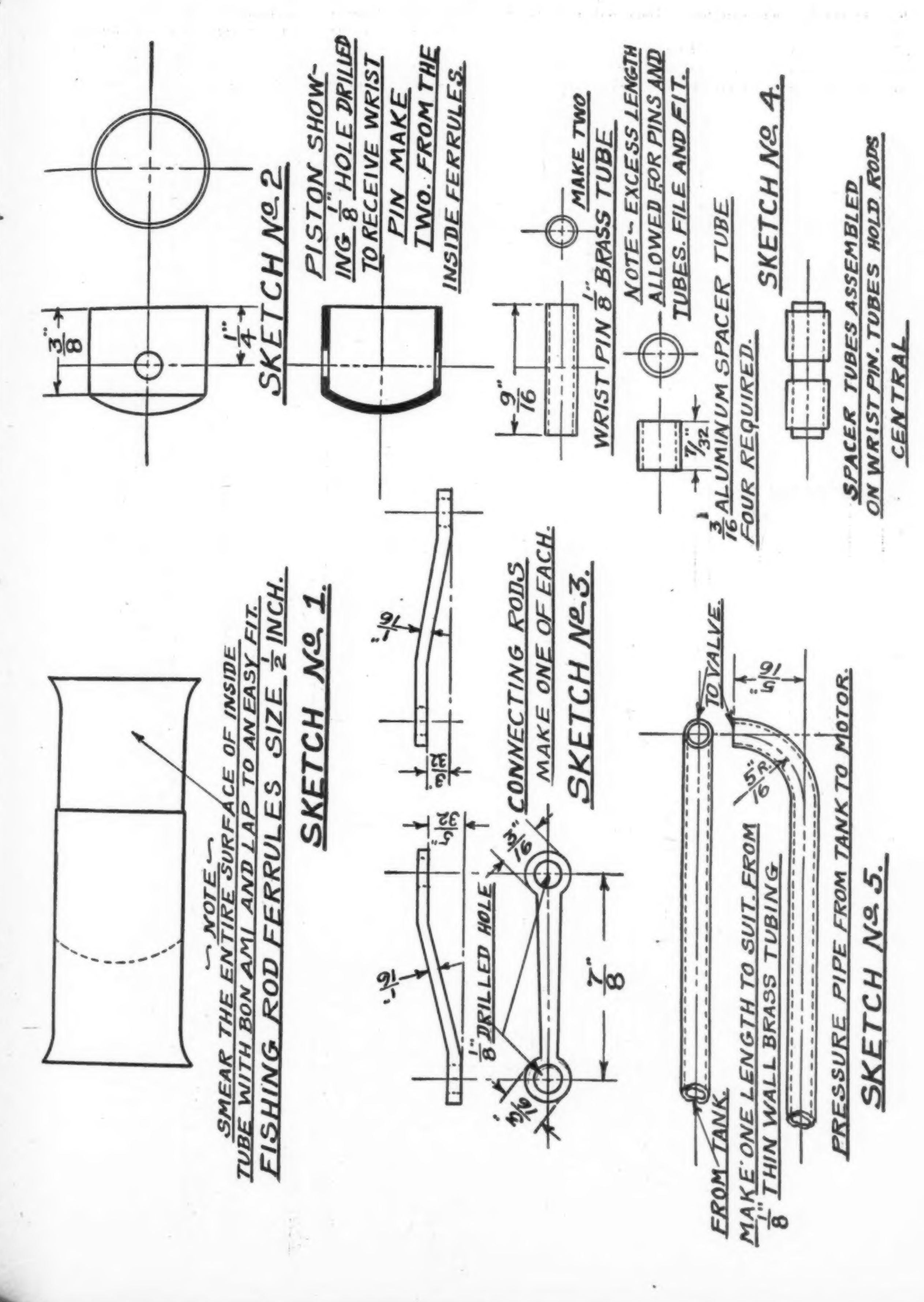
No. 3 by bending very carefully. These rods must be accurate.

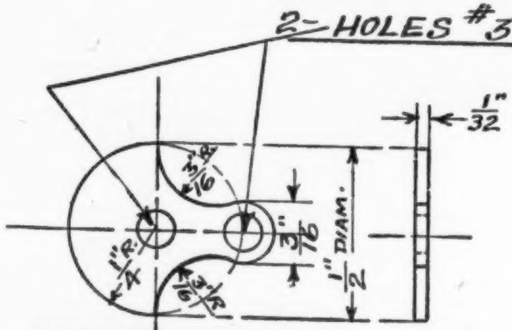
Small spacer tubes are cut from 3/16" thin wall aluminum tubing and assembled on wrist pins, sketch No. 4. Slip wrist pins, spacer tubes and rod ends in pistons and sweat solder wrist pins in positions. See sketch No. 6

This completes the piston and connecting rod assembly. Two such assemblies are needed, one for each cylinder of the motor.

The side frames for the (*Continued on page* 48)

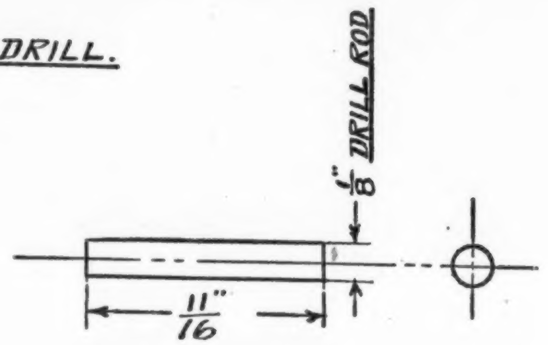



~NOTE~
SMEAR THE ENTIRE SURFACE OF INSIDE TUBE WITH BON AMI AND LAP TO AN EASY FIT.
FISHING ROD FERRULES SIZE 1/2 INCH.
SKETCH No. 1.
3/8"
1/4"
SKETCH No. 2
PISTON SHOWING 1/8" HOLE DRILLED TO RECEIVE WRIST PIN MAKE TWO. FROM THE INSIDE FERRULES.
1/16"
3/32"
1/16"
3/32"
3/16"
3/16"
7/8"
1/8" DRILLED HOLE
CONNECTING RODS MAKE ONE OF EACH.
SKETCH No. 3.
9/16"
WRIST PIN 1/8" BRASS TUBE
MAKE TWO
NOTE ~ EXCESS LENGTH ALLOWED FOR PINS AND TUBES. FILE AND FIT.
7/32"
3/16 ALUMINUM SPACER TUBE FOUR REQUIRED.
SKETCH No. 4.
SPACER TUBES ASSEMBLED ON WRIST PIN. TUBES HOLD RODS CENTRAL
TO VALVE.
5/16"
5/16" R
FROM TANK.
MAKE ONE LENGTH TO SUIT. FROM 1/8" THIN WALL BRASS TUBING
PRESSURE PIPE FROM TANK TO MOTOR.
SKETCH No. 5.



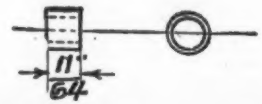
CRANK WEB. SHEET BRASS
ONE REQUIRED.

SKETCH No. 12.



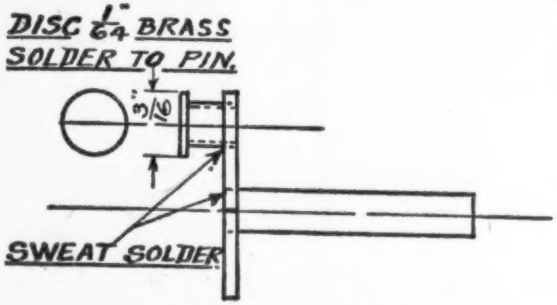
CRANK SHAFT.
ONE REQUIRED

SKETCH No. 13.



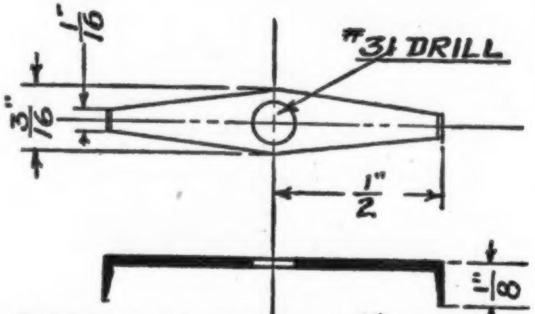
CRANK PIN. ONE REQ.
1"/8 BRASS TUBE.

SKETCH No. 14.



CRANK SHAFT ASSEMBLY

SKETCH No. 15.



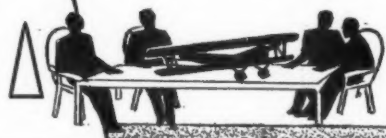
PROPELLER DRIVER. 1"/32 SHEET
BRASS. ONE REQ. SWEAT SOLDER TO
ENG. SHAFT AS SHOWN IN SKETCH No. 10

SKETCH No. 17.

CYLINDER HEAD
FORMED FROM 1"/32 SHEET
BRASS TO SUIT CYLINDER
TWO REQ.

SKETCH No. 18.

Aviation Advisory Board



Conducted by
Capt. H. J. Loftus-Price
EX-ROYAL AIR FORCE
CHAIRMAN OF THE BOARD

LAST month we started to give you full details of the many famous Sopwith machines of World War fame, and prior to that date. The last one mentioned in that issue was the Baby Seaplane. We now continue with the 1½-Strutters.

The 1½-Strutters (*December* 12, 1915, *and June* 7, 1916): This Sopwith 1½-Strutter has claims to great historical distinction, not only for its great capabilities for use as a fighter, but because, indirectly, it set a new fashion in aerial fighting, being the first British airplane to carry a synchronized gun firing through the propeller. The Sopwith Kauper synchronization gear which made this possible was developed at the Sopwith works, and was as much a product of this firm as was the machine in which it was installed. It was also fitted with the Scarfo gun ring for the gunner, which has since become a well-established feature on all fighters.

The 1½-Strutter was originally designed as a high-performance two-seater fighter, with a 100 h.p. Clerget engine. At the time of its introduction it was justly regarded as an extraordinarily good 'bus, having an excellent performance and a good maneuverability. Incidentally it established a world's altitude record for an altitude of 23,980 feet. In view of its good performance, coupled with its (for the times) excellent armament, the 1½-Strutter had a tremendous success, and it is not surprising that many machines were built to the order of the governments of Roumania, Russia, America and Belgium. In addition, it might be mentioned that the French Government manufactured under license no less than 4,500 machines of this model.

In addition to the novel points connected with the mounting and firing of the guns carried, the 1½-Strutter was interesting in several other respects. Thus the wing bracing—which gave it its name—was very unusual, and in a modified form set a new fashion, so to speak. The top plane was in two halves, bolted to the top of a central cabane, while the spars were provided with an extra support in the shape of shorter struts running from the top longerons to the top plane spars some distance out.

In the single-seaters to follow this bracing of the top plane was generally adopted, with the exception that the central cabane was done away with, the outer struts of the "W" formation having a slightly less pronounced slope, and supporting a separate top wing centre section. The 1½-Strutter was fitted with an air brake in the form of adjustable flaps in the trailing edge of the lower plane adjacent to the fuselage. These flaps could be rotated by the pilot until they were normal to the wind, thus helping to pull the machine up when about to land.

A more successful innovation incorporated in this machine was the trimming gear, by means of which the angle of incidence of the tail plane could be altered during flight. In this manner the difference in weight of the passenger carried could be counteracted by the tail setting, and also the tail could be adjusted for high speed, climbing, etc. This feature has since become universal practice on passenger-carrying machines.

THE *1½-Strutter Bomber*: Originally designed as a two-seater fighter, the 1½-Strutter was later adopted as a single-seater bomber, and was the machine which was so successful in bombing, with good results, such towns as Essen, Munich and Frankfort. For bombing work the 1½-Strutter was equipped with a 130 h.p. Clerget, which afterwards took the place of the 110 h.p. Clerget in the standard two-seater fighter model. Later the French Government converted a large number of two-seaters into school machines with dual controls. These were fitted with 80 h.p. Le Rhone engines.

The Sopwith "Pup" (*February* 9, 1916): This famous single-seater scout bears a strong resemblance to the Sopwith "family," being reminiscent of both the 1½-Strutter and of the original "Tabloid." The "Pup" was brought into existence principally with the object of tackling the Fokker monoplanes that were at one time doing far too well on the Western Front. In this object it succeeded admirably, and although judged by present standards it was of very low power—it was fitted with an 80 h.p. Le Rhone engine—its performance and ease of handling endeared it so much to its pilots that its merits are still spoken of with much affection, tingled with a little regret that it had to give way for higher-powered machines.

One of the famous "Bristol Fighters"

(*Continued on page* 43)

A Course in Airplane Designing

By Mastering This Valuable Course, the Model Builder of Today Lays the Cornerstone for His Career as the Aeronautical Engineer and Designer of Tomorrow

By Ken Sinclair

article 26.

IN presenting this course, MODEL AIRPLANE NEWS *wishes to stress the fact that model building is more than a mere sport. If the builder of model airplanes learns the fundamental principles underlying airplane flight and design, he prepares himself for a future career in the most profitable phase of aviation.*

The policy of MODEL AIRPLANE NEWS *is not to encourage or teach its readers to become pilots, but rather to become aeronautical engineers, designers, salesmen, manufacturers, or equip themselves for many other positions which require the training of the specialist or executive. Study this course from month to month, master it in every detail and you will gain a fundamental knowledge of the how and why of airplane design which will be second to none.*

THE EDITOR.

AS we learned last month, the seaplane float presents some rather difficult problems to the designer. By getting down to the basic ideas and principles of the thing, however, we found that the matter is not nearly as complicated as it seems at first glance. This month we will go on with our discussion.

We have said that, first of all, a seaplane float must be a good boat. It must support the weight of the plane on the water. Not only this, but it must support the plane, *with no danger of tipping in any direction,* under practically any conditions, stormy or calm, rough water or smooth.

Last month we spoke of lateral stability in the water, learning that twin pontoons, or a single pontoon with wing-tip floats or perhaps sponsons, may be used to keep the ship from tipping sideways in the water. Now we will turn our attention to longitudinal stability.

Longitudinal stability means just this; that the float or floats shall be capable of supporting the plane in the water without allowing it to tip forward or backward, whether the plane is at rest or moving through the water or taking off or landing. Sounds like a large order, doesn't it? It is not as hard as it sounds when we stop to think about it.

Distribution of buoyancy is the answer. As we learned last month, a float supports the weight of an airplane in the water by displacing a certain amount of the water. If the plane weighs one pound complete and including the float, the float will displace exactly one pound of water when at rest.

However, to get back to the matter of longitudinal stability, suppose we build a float like that shown in top and side views in Figure 1. Here we have a pontoon, or float, that has a great deal of volume up toward the front and very little (because of the thin, tapering after-portion) toward the stern.

Take a good look at the sketch. Then think about it for a moment. How will this pontoon be for longitudinal stability? Will it keep the plane from nosing over in the water? Will it keep it from sinking tail-first if a wave gets under the bows and rears the plane up like a balky cayuse?

Figure 1

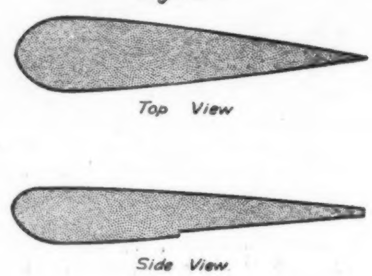
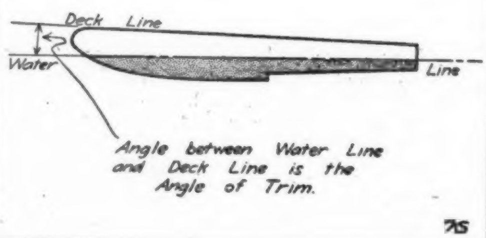


Figure 2



Looking at the float carefully we can see that something is wrong. Still, from the standpoint of air resistance while flying, the thing looks fairly good, doesn't it? That long, tapering stern with the rounded nose makes a fair streamline.

However, don't jump to conclusions. Remember—we have said that, *first of all,* a good pontoon must be a good boat, and, looking this sketch over, we see that the pontoon has not enough volume toward the stern. While the front portion will displace a good amount of water and obtain a great deal of buoyancy, the stern, because of its thin, tapering shape, has very little volume. The buoyancy is all up forward. Therefore the float can support very little weight on the stern.

Well, what of it? Just this. Perhaps the float, or a pair of them, can support a plane on the water all right. The plane will ride nose-high, with the stern of the pontoon nearly under water, but it's still afloat. Now, however, suppose a sudden gust of wind comes along and catches our airplane. Naturally, the plane will swing around and nose into the wind because of the action of the air on the vertical fin and the rudder.

What will happen? Neglecting the action of the waves, the wind will exert a lifting force on the wings of the plane, raising the forward portion and, at the same time, blowing the plane backward along the water. Remember, the pontoon is already awash by the stern. Now we find that, with the plane tipped up as it is by the wind, the weight is thrown on the rear portion of the float—the portion that, because of its tapering (*Continued on page 46*)

A real Airistocrat—three-quarter view

An AIRISTOCRAT Flying Model

By

Ben Shereshaw

BY building a model of the Airistocrat, you can make an exceedingly attractive type that heretofore has not been seen in model airplane tournaments. Also, you can construct a model that, unlike most scale models, will fly a great distance.

The model of the Airistocrat monoplane which was designed exclusively for MODEL AIRPLANE NEWS readers will fly consistently from four hundred to six hundred feet. The longer flights were made downwind, hand launched, but it also takes off under its own power after a run from three to five feet.

To make the task somewhat easier for you, drawings have been prepared which show all the essential details full size.

This can be classed as the most advanced type of flying scale model and yet any careful model builder can construct it. If the builder uses painstaking workmanship he will have a handsome model and a good flyer.

FUSELAGE

The fuselage is constructed of 1/16" x 1/16" white holly. White holly was chosen because of its extreme strength and flexibility. We have eleven bulkheads and four intermediate stations; namely a, b, c and d.

To assemble sides, lay the full size plan of the fuselage on a flat board. Then to make the jig for the fuselage, insert brads in such positions around the longerons on the drawing as to make a very effective jig to hold the 1/16" x 1/16" longerons in place.

Cement the nose strut No. 1 in place, and proceed by cementing struts 2, 3, 4, etc., until you have reached the tail post. Let the cement dry for one hour until it is clear and hard. To make the other side, proceed in the same manner. Care should be taken to make all joints flush.

The next step is to assemble the fuselage, which means you have to connect the two sides with cross members. The sizes of all the cross members are obtained from the drawing showing the top view of the fuselage. The cross members are also made from 1/16" x 1/16" white holly. The members are then cut and inserted, starting from bulkhead 10 and working forward towards the nose.

While the cement is still setting, it is a good idea to check your fuselage over with draftman's triangles. When the assembly has thoroughly dried, bind your tail posts together with silk thread.

THE next step is to make the metal fittings for the motor stick. The front motor stick clip fits at bulkhead No. 1 and the rear clip at bulkhead No. 7. The clips are made of No. 8 piano wire. The clips should be ⅛" wide and should be long enough to reach the depth of the bulkhead plus the depth of the motor stick. Below the motor stick bend a slight inset to keep the stick from slipping out; then bring the ends of the clips up across the bulkhead, which is made of 1/16" flat balsa and cemented into place.

The next clip is stationed at bulkhead No. 7, only this one is larger, because the cross section is larger. Make the bulkhead and the clip in the same manner as in the first clip.

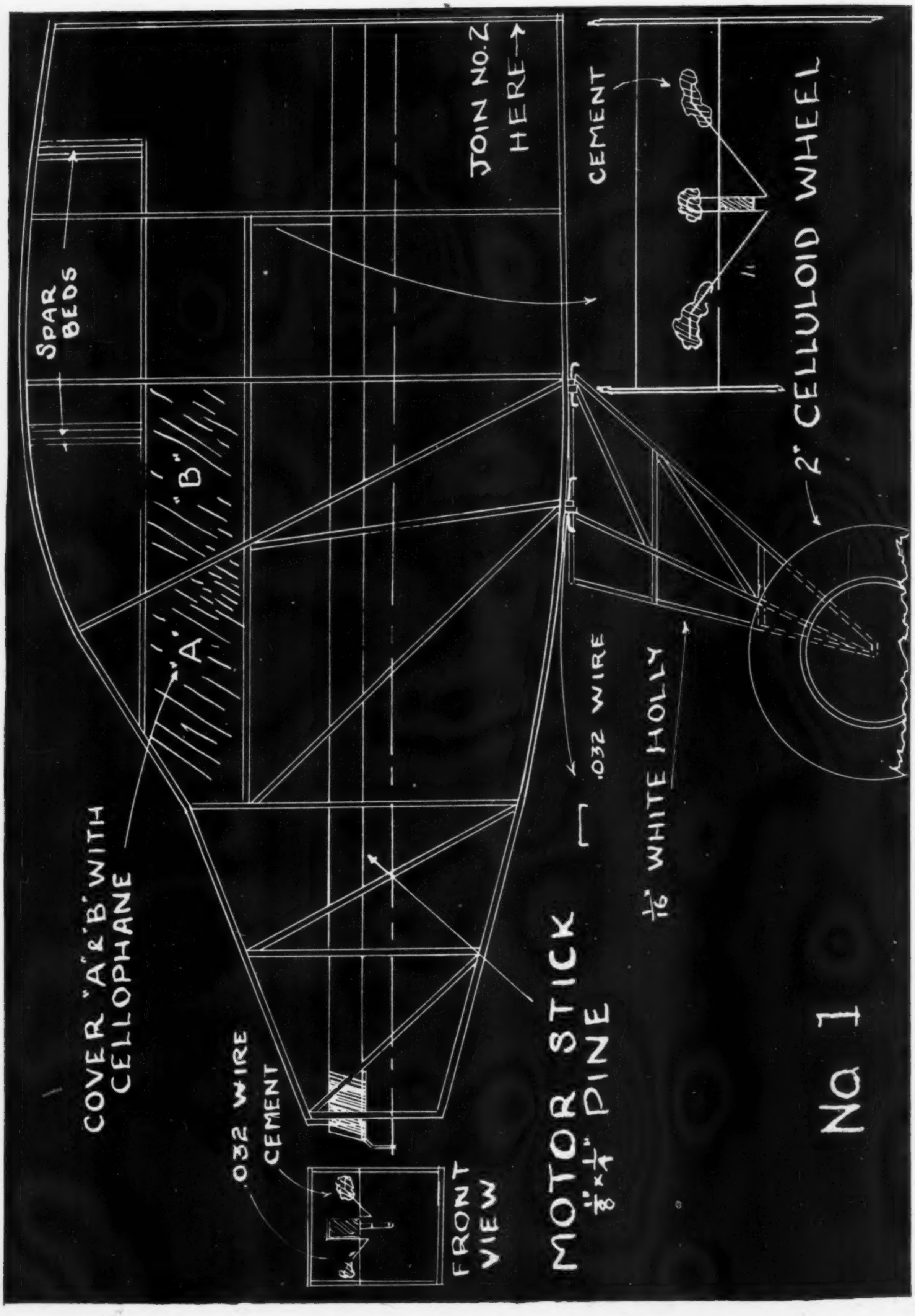
Now install your upper and lower window sills which are made from 1/16" x 1/16" white holly. These now form windows through which you will be able to insert your fingers and disengage the motor stick.

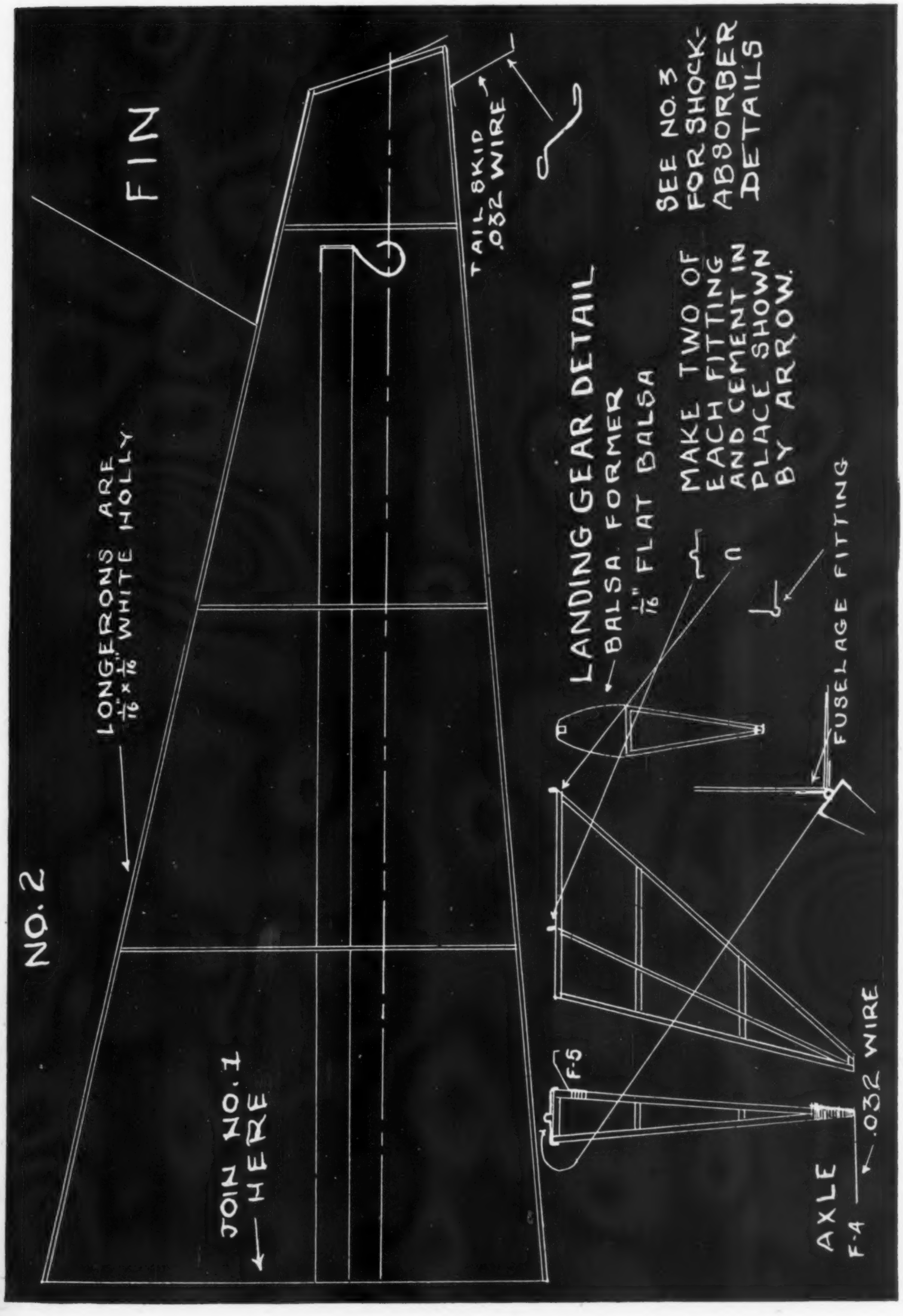
The next and most important step, is to build up your spar beds, from 1/16" x 1/16" white holly as shown in the side view of the fuselage. Great care should be taken to see that the spar beds have no angle of incidence. Cement your landing gear bearings in place at their designated stations. Your fuselage is completed now and should not weigh more than .65 of an ounce.

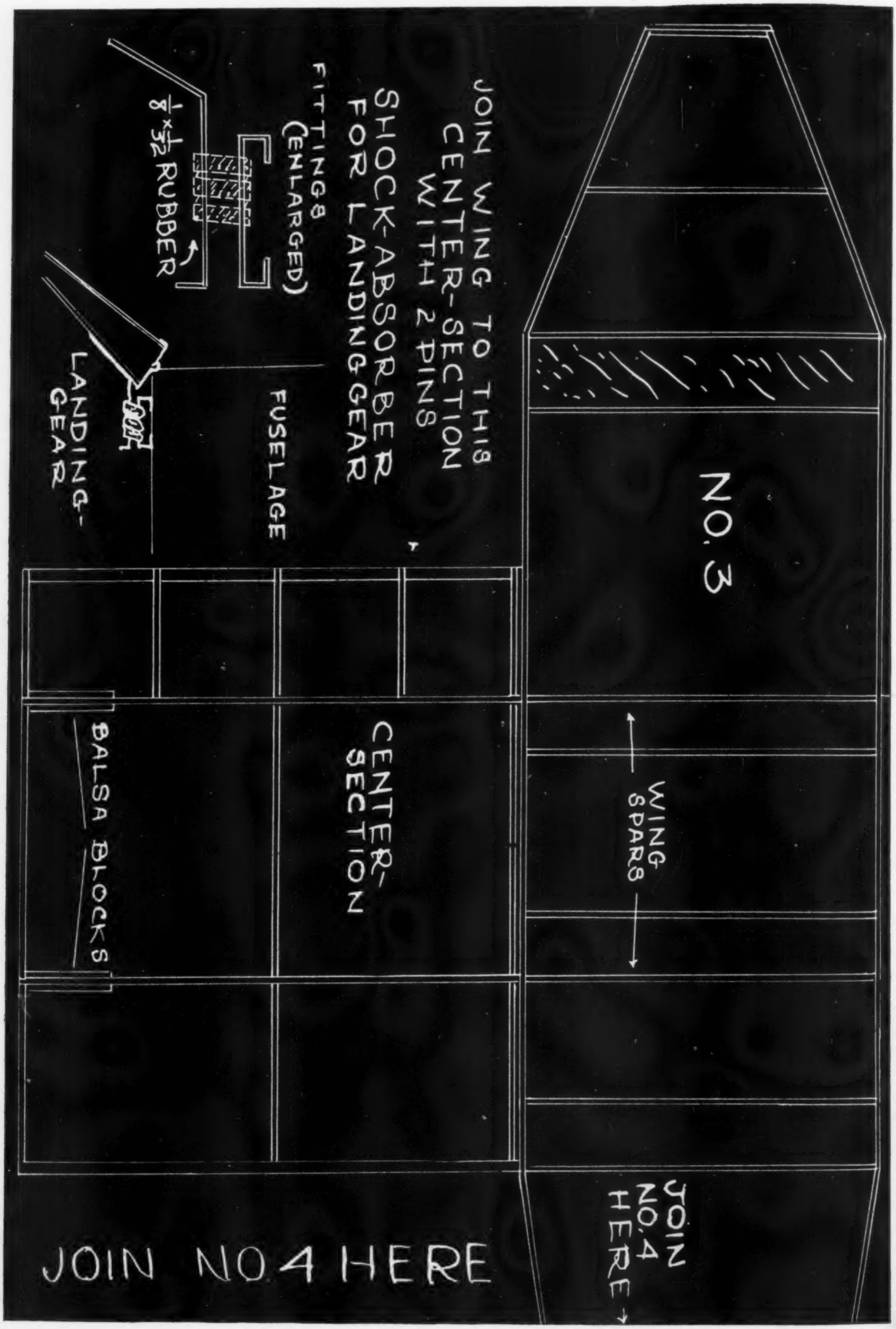
A Scale Model With First-Rate Performance

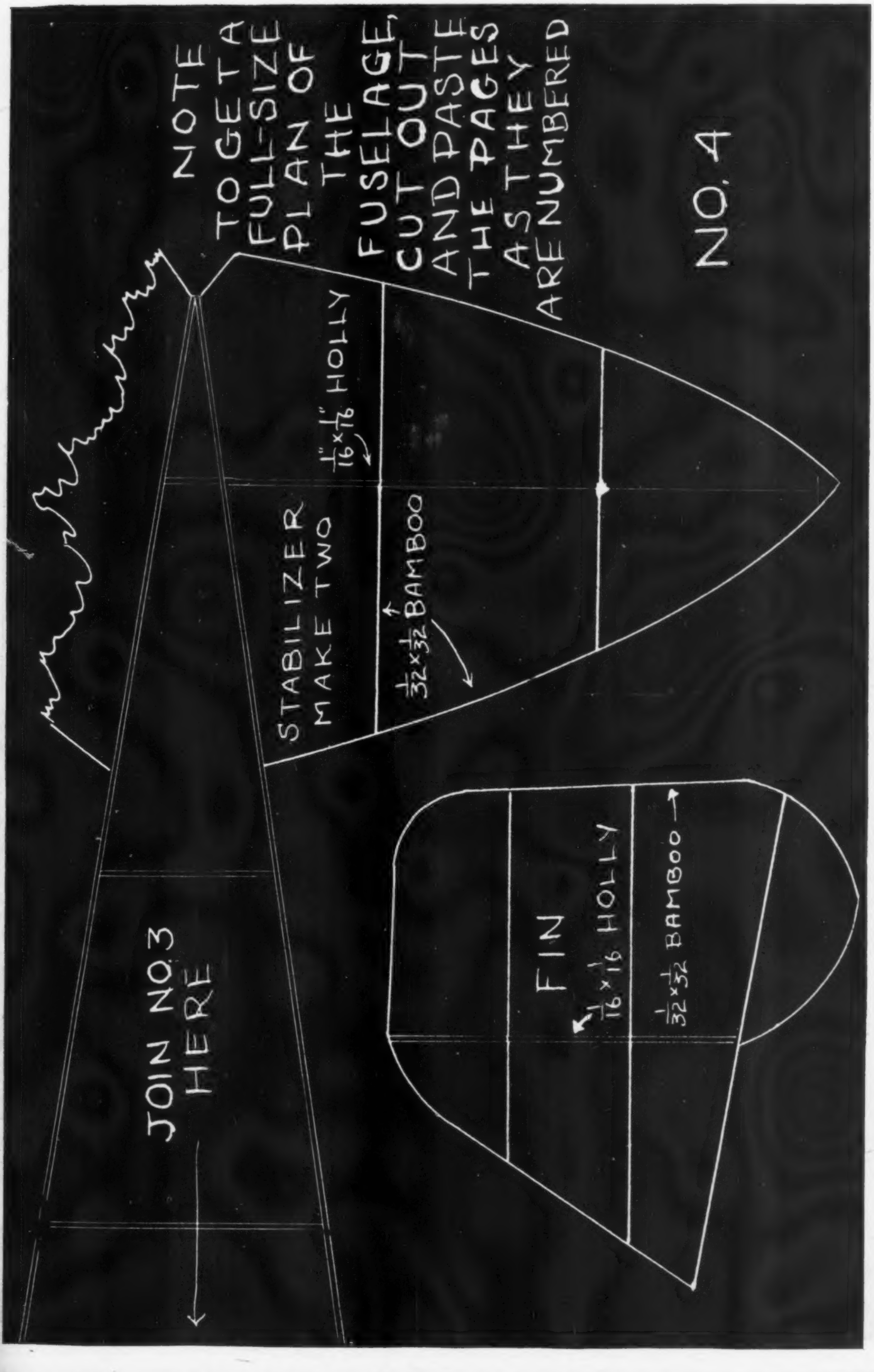
LANDING GEAR

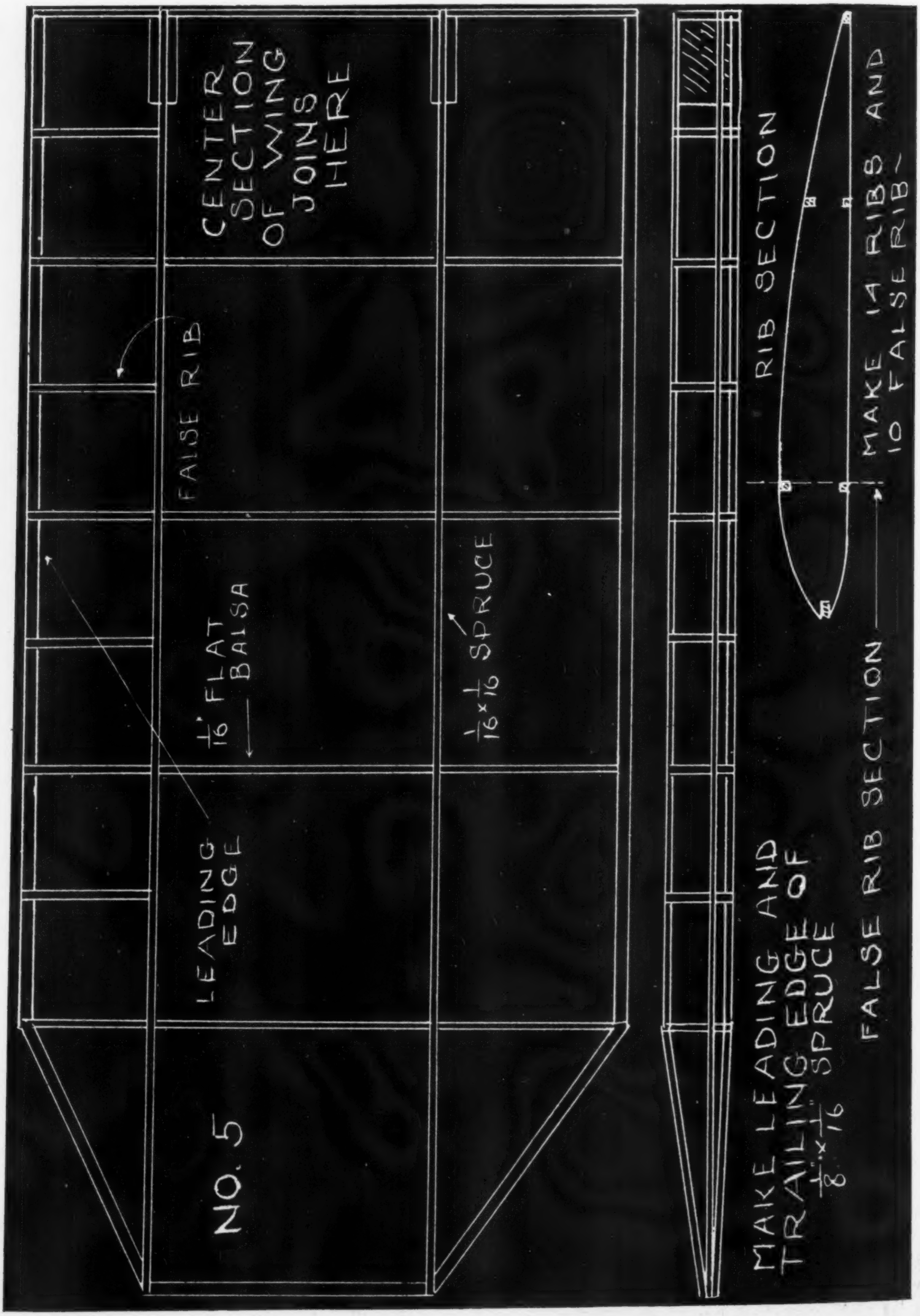
The under- (*Continued on page 45*)

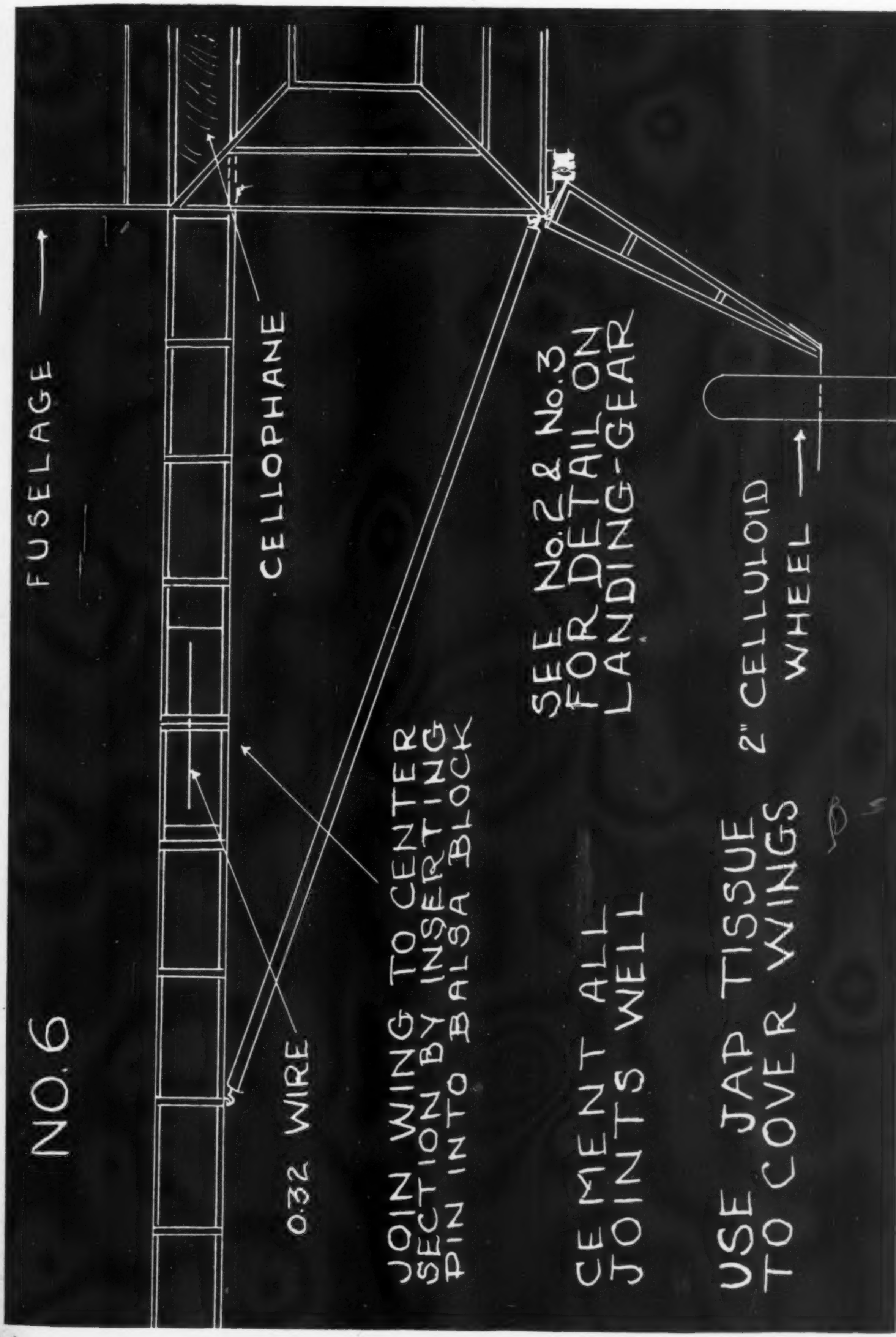

SPAR BEDS
JOIN No. 2 HERE→
CEMENT
"B"
"A"
COVER "A" & "B" WITH CELLOPHANE
.032 WIRE
1/16" WHITE HOLLY
2" CELLULOID WHEEL
MOTOR STICK 1/8"×1/4" PINE
.032 WIRE
CEMENT
FRONT VIEW
No 1

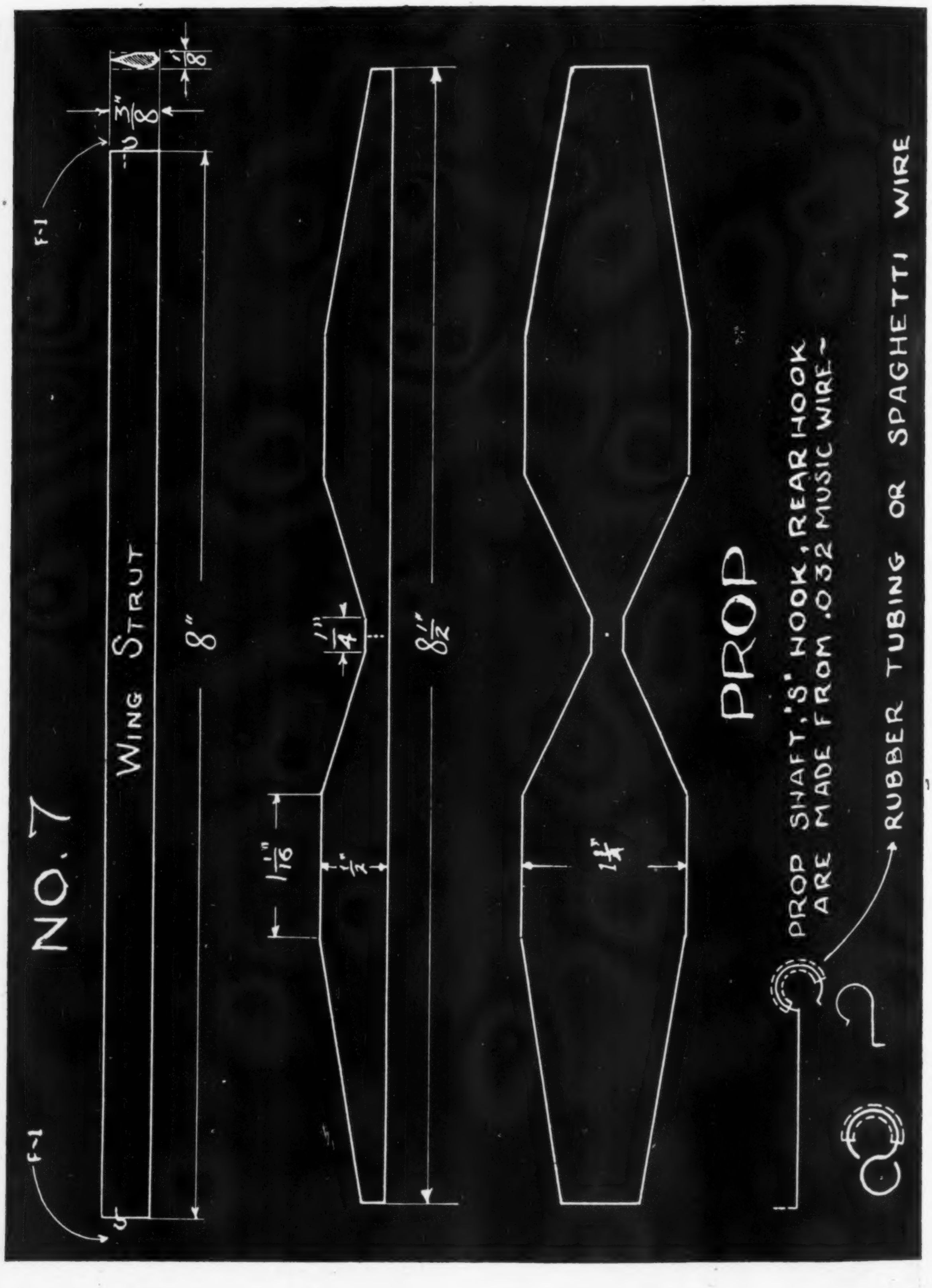

NO. 2
LONGERONS ARE 1/16" x 1/16" WHITE HOLLY
FIN
TAIL SKID .032 WIRE
SEE NO. 3 FOR SHOCK-ABSORBER DETAILS
LANDING GEAR DETAIL
BALSA FORMER
1/16" FLAT BALSA
MAKE TWO OF EACH FITTING AND CEMENT IN PLACE SHOWN BY ARROW.
FUSELAGE FITTING
JOIN NO. 1 HERE
F-5
AXLE F-4
.032 WIRE


JOIN WING TO THIS CENTER-SECTION WITH 2 PINS
SHOCK-ABSORBER FOR LANDING GEAR
FITTINGS (ENLARGED)
1/8 x 1/32 RUBBER
FUSELAGE
LANDING-GEAR
NO. 3
CENTER-SECTION
WING SPARS
BALSA BLOCKS
JOIN NO.4 HERE
JOIN NO. 4 HERE


NOTE
TO GET A FULL-SIZE PLAN OF THE FUSELAGE, CUT OUT AND PASTE THE PAGES AS THEY ARE NUMBERED
NO. 4
STABILIZER
MAKE TWO
1/16" x 1/16" HOLLY
1/32 x 1/32 BAMBOO
JOIN NO. 3 HERE
FIN
1/16 x 1/16 HOLLY
1/32 x 1/32 BAMBOO


NO. 5
LEADING EDGE
1/16" FLAT BALSA
1/16 x 1/16 SPRUCE
FALSE RIB
CENTER SECTION OF WING JOINS HERE
MAKE LEADING AND TRAILING EDGE OF 1/8" x 1/16 SPRUCE
FALSE RIB SECTION
RIB SECTION
MAKE 14 RIBS AND 10 FALSE RIBS


NO. 6
FUSELAGE
CELLOPHANE
0.32 WIRE
JOIN WING TO CENTER SECTION BY INSERTING PIN INTO BALSA BLOCK
SEE No. 2 & No. 3 FOR DETAIL ON LANDING-GEAR
CEMENT ALL JOINTS WELL
USE JAP TISSUE TO COVER WINGS
2" CELLULOID WHEEL


NO. 7
WING STRUT
F-1
F-1
3/8"
1/8"
8"
1/4"
8 1/2"
1 1/16"
1/2"
1 1/4"
PROP
PROP SHAFT, 'S' HOOK, REAR HOOK
ARE MADE FROM .032 MUSIC WIRE –
RUBBER TUBING OR SPAGHETTI WIRE

Gliding and Soaring

(*Continued from page* 8)

landing. However, any airplane can maintain a fixed altitude, if it is possible to find upward currents providing a lifting force equal to the airplane's sinking speed.

Thus, your ability to soar in an airplane depends on the strength of the upward currents over which it is flying, and its own angle of glide. The lighter the wing loading, and the more streamlined the design, the flatter will be the airplane's angle of glide. The stronger the prevailing wind, and the steeper and higher the mountains, the better will be the opportunities for soaring over any given region.

No one who is unskilled, both as an airplane and as a glider pilot, should attempt to glide a motored plane over rough terrain. Air currents in mountainous regions are apt to be treacherous, and infinite care and experimentation should precede any such effort.

It is often impossible, while flying with the motor running, to detect upward currents. Therefore, it is best to choose a position where the upward currents are likely to be strong, to throttle down the motor, and to feel about until the wind gives the plane a noticeable lift. Once the plane begins to soar, you should hold it to its normal angle of glide, and maneuver just as if you were soaring a glider.

The Gliding of Motored Planes as a Postgraduate Course. The French government has already started a school, under the direction of Lieutenant Thoret, which teaches licensed army pilots how to glide motored planes. This is an important and new use of the principles of gliding, and illustrates the way in which the advances made in gliding may contribute to the science of aviation. As the gliding of motored planes is further developed, it is probable that more and more pilots will realize new possibilities for its application.

The gliding of motored planes is a development of great moment. It is, however, still in an experimental stage, and has been attempted by comparatively few people and in only a few places. Thus, although it is dangerous for unskilled flyers, it offers a competent pilot excellent opportunities for research.

As to the future of the glider movement, it will undoubtedly do much toward increasing air-mindedness of the American public, according to many leaders of aviation who were consulted. As one manufacturer expressed it, the glider will be to aviation what the crystal set was to radio. It will permit the youth of the country to experiment with this new activity at low cost and will stimulate a rate of development which would have been impossible by any other means. The vogue of the glider will result in better vehicles of the air.

The progress which has been made in soaring flight and in glider construction during the last decade is probably indicative of the great advances which gliding will make in the future. No one can predict what flight secrets will be disclosed to the glider pilot nor to what extraordinary ends the principles of gliding will be applied. Nevertheless, some of the glider's potentialities are already apparent.

How Gliders May be Improved. The glider's chief shortcoming at present is its uncertainty of propulsive power. A pilot cannot set out in a glider from one city to go to another; he must travel wherever rising currents of air are available. He will not cover much distance unless he is both skillful and fortunate. There are several ways in which gliders may possibly be improved to offset this drawback.

Auxiliary Engines. In the first place, it is possible to equip gliders with light engines. Numerous experiments in this line have been successfully carried out. The engine must be used to gain altitude only when there are no upward currents; the pilot "cuts the gun" and soars as soon as he reaches a good soaring terrain. Such engines must, of course, be light in weight. Although they are often built with only one cylinder, they have occasionally enabled gliders to attain speeds of 40 or 50 miles an hour.

Such motors should only be installed in advanced ships with the approval of the Department of Commerce and for the use of experienced pilots.

Although even a light engine increases the ship's weight, the glider with an auxiliary engine has advantages over an airplane, owing to the glider's light wing loading. Many motored gliders use a skid instead of wheels to keep the weight low, and are launched by rubber shock cords. Although the structure of a glider must be reinforced when an engine is added, this strengthening does not necessarily add greatly to the weight.

A powered glider lands, of course, exactly like one without a motor, which means that the only increase in landing speed is that due to the small additional weight of the motor. Such speed is very much less than a regular motored ship. The chief value, of course, is that as soon as a glider has attained some altitude, and found the proper air currents, it can then glide for long distances without power.

In spite of the interest taken in gliders with auxiliary engines, however, Dr. Georgii, a renowned German authority, stated recently that motored gliders were "unsatisfactory both as gliders and as power airplanes" and that this line of development, except for special purposes, has been given up by the German Association for Soaring Flight. Most glider enthusiasts agree with him.

Robert B. Evans, president of the National Glider Association, says that, although light motors are comparatively safe, it is unwise to install them, since people soon begin to want heavier ones.

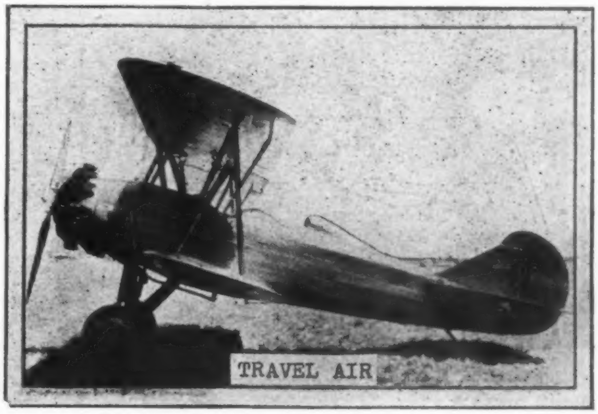
On the other hand, Glenn Curtiss, who had long years of glider experience, said:

"The best way, in my opinion, to learn to fly a glider is to put a motor in it.

"In the early days of my interest in aviation, I considered work with gliders as pretty much a waste of time. My idea of the best way to learn to fly was to use the motor with a screw propeller attached direct to the engine shaft in whatever type of flying machine we wished to try out, and run, preferably, over the ice, but if the ice was not available, on wheels on a smooth road or parade grounds. This is the way we did learn to fly. I am now confident this plan was sound. We experimented with gliders but learned little about flight.

"Today, flight is pretty well understood and many people know how to fly and have good machines in which to fly. Gliding is desirable as a sport and recreation. The equipment is, of course, comparatively inexpensive, but light inexpensive motors will soon be available and the glider will become a motor glider."

A popular type of sportsman's plane—the Travel **Air**



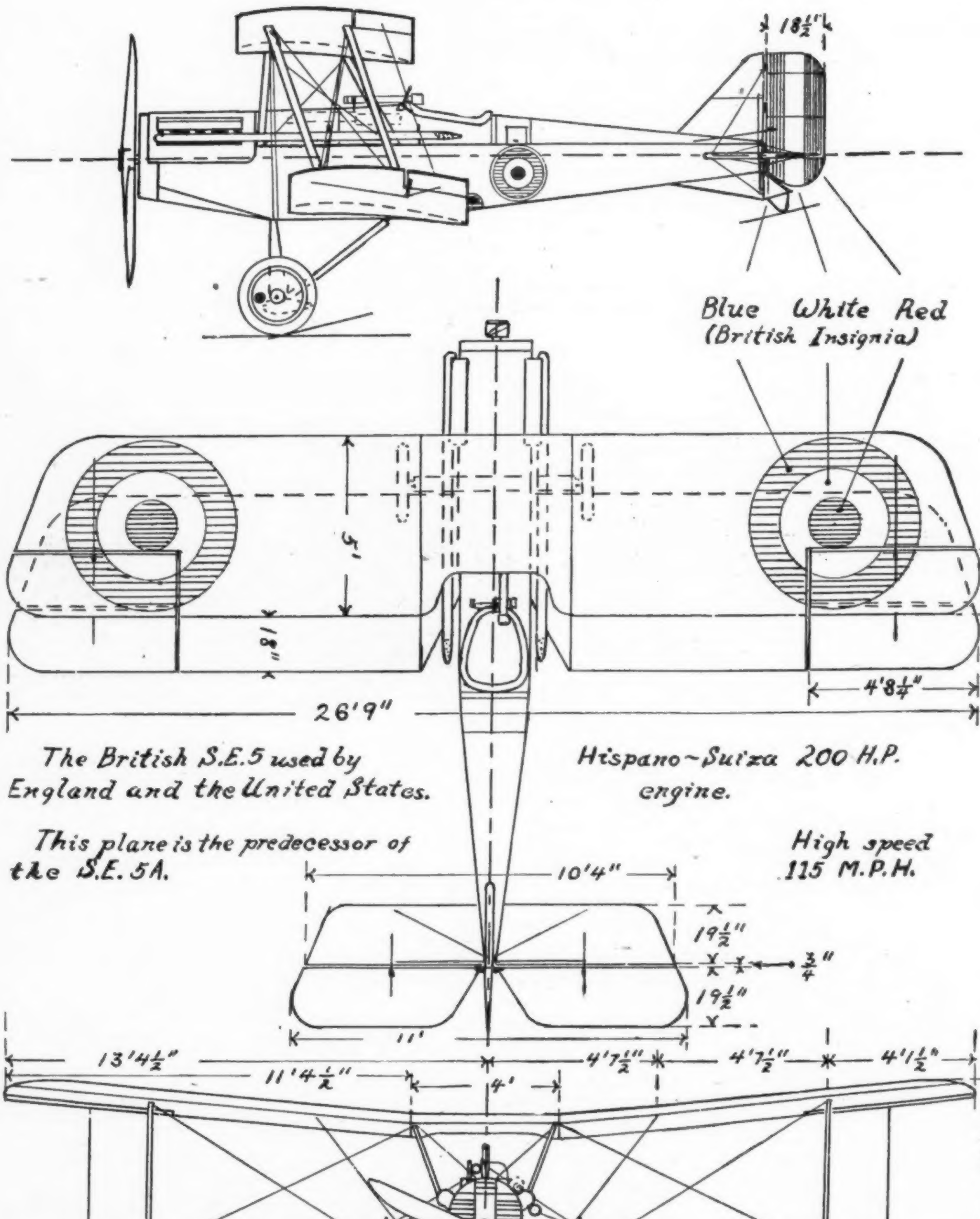
The future of this controversial subject is yet to be revealed. The consensus of opinion among the men consulted is summed up by one official, who says.

"At the present time it looks as though the power glider will follow within the very near future. Straight gliding is not going to satisfy the present non-flyer very long. He will want to stay up longer than just a few moments. Since we feel this is the case, we are preparing to bring out a glider to which can be attached at a later date, if desired, an 8- or 10-horsepower engine which is being developed for us. The glider itself will sell for around \$500 and the engine as a separate unit for \$150. When the buyer is tired of his glider and wants to stay up longer than usual, and go places, he can buy this little engine, put it on his glider, and make 45 to 50 miles an hour across country."

According to the president of another company,

(*Continued on page* 37)

The Famous World War S. E. 5 Single Seater Fighter



"There is at present a missing link in aviation between the 10-mile-an-hour glider and the 40-mile-an-hour airplane. The glider with a small motor will fill this gap. It will have dual controls and will carry two persons, seated side by side. My company is placing such a plane on the market.

"After having learned to fly the glider, the student pilot will seat himself in the power glider beside an airplane pilot. Together they will hop around until the student has had an hour or so of power flight. Then he will solo, and thereafter fly alone to build up experience.

"Having accustomed himself to wings in his previous experience at flying the glider without power, the student pilot has no difficulty with his new vehicle. The motor merely takes the place of the shock cord in towing or launching. Should the motor go dead, he is not terrorized or helpless. He is in the same position as when the cord was released. He instinctively picks out a place to set down.

"Thousands of clubs now flying gliders, with an investment per member of about $25 will tire of just hopping up and down. They will want power on their wings. They will be found flying about behind a little putt-putt motor which costs them about $50 per member. Fuel costs will be so low as to be almost negligible; 50 to 65 cents per hour. Depreciation costs will be small because of the low investment.

"To the student pilot who has flown the glider with and without power, the step to flying the real airplane is now short and easy."

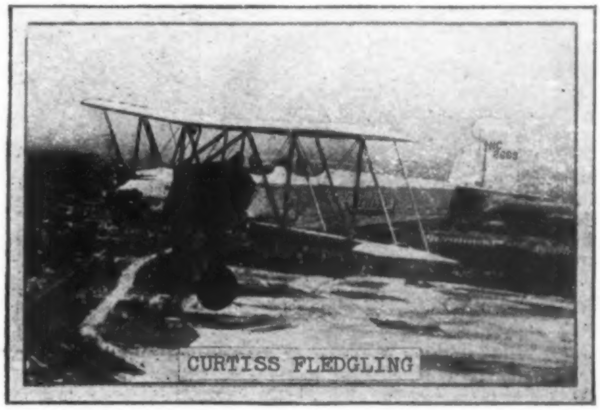
Rocket Planes. Rockets, as well as internal combustion engines, may be used at some future time, to give the glider altitude over regions where there are no upward currents. Although some tests have been made of rocket planes, they are still wholly experimental.

A rocket plane is propelled by a series of rapid explosions which act on it somewhat as a rifle shot does on a bullet. The rockets are usually arranged behind the pilot's cockpit below the wings. A ship equipped with rockets might be enabled to take off under its own power, although this is not yet practical, or may be launched into the air before the rockets go off.

A plane which flies under the power of continually exploding rockets might become, in time, superior to an airplane with a gasoline engine. It has possibilities of greater speed, and also (unlike an airplane with a propeller) it becomes increasingly effective as the air becomes less dense. At present, however, planes cannot carry enough powder (or other "fuel") to enable them to make long flights by means of rockets; designers have not yet learned how to avail themselves of the greater part of the power created by the explosions. A ship which is propelled by continually exploding rockets is, of course, not a glider, but a power plane.

Contributions of Gliding to the Science of Wind Currents. The future of gliding lies in the contributions which it can make to other sciences, as well as in the improvements and new uses which may be found for the glider itself. Since soarers are extremely sensitive to currents of air, they provide the best possible means of discovering the effectiveness of vertical, and possibly of horizontal gusts of wind, how gliders can avail themselves of clouds, etc. Many of the advances made in this field of meteorology have been made by students of soaring.

A knowledge of the way to recognize wind currents before they are gone is as necessary to the pilot as is a knowledge of the wind currents themselves. Soarers might accordingly be equipped with antennae, which would indicate the state of the air ahead. The antennae might consist of a pole, perhaps 10 feet in length, projecting from the nose of the ship, with a wind vane or "feeler" at its end. Such an indicator would allow the pilot to make greater use of approaching wind currents than he is now able to do. Experiments in this direction have already been made; but they have so far been unsuccessful, since they do not notify the pilot sufficiently ahead of time.



An outstanding Training plane, the popular Curtiss Fledgling

Contributions of Gliding to Aerodynamics and to Airplane Design. Because gliders are light and comparatively inexpensive, because their speed is low and they are not subjected to vibration and the shocks of landing, it is safer to make experiments with them than with high-powered airplanes. Gliders have already greatly quickened the progress of aerodynamics and of airplane design, and they bid fair to make still greater contributions to these sciences.

For example, a good many attempts have been made to eliminate ailerons from gliders, although no very practical substitute has yet been found for them. Ailerons are an imperfect form of control, at best. They destroy the streamline shape of the wings when they are raised or lowered; and when they are in neutral position, there is a gap between them and the wing. Consequently, numerous gliders have been built with flexible wings, warpable wings, or wings the angle of incidence of which can be changed.

The Future of Gliding in America. Even before the glider has been improved or adapted to new purposes, it will, doubtless, become more and more widely used in America as a sport and as a means of flight training. The proof of this prediction is already suggested by the growing number of glider clubs and of airplane schools which are beginning to use gliding as the initial step in flight instruction.

In a survey which we have made of the attitude of prominent officers of the aviation industry throughout the country, the opinion is strongly held that the glider is going to have a definite and a favorable effect on aviation at large.

F. B. Collins, of the Boeing Airplane Company of Seattle, Washington, says that the effect of gliders on the aviation industry should be beneficial, since the sport of gliding will, without doubt, serve to play a prominent part in promoting the air-mindedness of the general public.

Gliders, through their low cost of construction and consequent low price, may not prove a source of great revenue to manufacturers, but they will be a means toward the end of creating powered airplane sales. H. Newton Whittelsey, of the Whittelsey Manufacturing Company, of Bridgeport, Connecticut, says: "I believe the effect, whatever its amount, will be beneficial to the aviation industry, if the manufacturers are careful to make only good gliders, and to guard their use to prevent serious accidents."

According to one of the Waco executives, gliders are going to be the salvation of the aviation industry. "We think," he says, "they will greatly increase the sale of airplanes. We consider them such a contribution to aviation that we are going into the manufacture of them."

G. R. Coats, of the Berliner-Joyce Aircraft Corporation of Baltimore, Maryland, says: "There is no doubt that a glider at a few hundred dollars' cost is going to enable many to get in the air who would be unable to do so otherwise. In other words, flying adds a new dimension to life, and it seems that we are all seeking new dimensions."

Edward D. Stinson, president of the Stinson Aircraft Corporation of Detroit, Michigan, says: "I believe gliding, properly supervised, will do more to assist aviation than anything I know of."

Conclusion. The public must be educated to the essential safety of flight. Gliding will be an important means of teaching how all flight may be made safer. It will also serve as the instrument for carrying such an educational program.

This ends the series on Gliding and Soaring, which we feel sure has aided you greatly in understanding this newest and most thrilling of air sports.

THE EDITOR.

Engine Course

(*Continued from page 6*)

of the shaft. However, in Vee and other similar engines, difficulties are found. Two connecting rods must be secured to the same crankthrow. If the crank were to be widened, the rods might be laid side to side. This would lead to an excessively long crankshaft, however, with its increased weight.

The common practice is to use a "fork and blade" construction. Here one rod has its lower end split in two. Between these parts is inserted the blade or lower end of the other rod. Thus, both connecting rods function on one crankthrow.

Another method is to secure one rod to the crank. On this rod is a lug which is drilled. Through this hole is pinned the other connecting rod.

The radial type of engines have an ingenious solution to this problem. Since all of its cylinders lie in one plane, provisions must be made to secure all the connecting rods to the one crankthrow. A master articulated rod is pinned to Number One piston. Around the lower end of this rod are drilled holes to which are pinned the ends of the remaining articulated rods or links.

Thus, in a nine-cylinder engine there will be eight articulated rods secured to the master rod. The large end of the master rod may be made in one piece as in the Pratt, Whitney engines, or it may be built up from two pieces as in the Wright engines.

We have now traced the path of the power from the combustion within the cylinder to the lower ends of the connecting rod. We will now follow it until it is delivered directly to the propeller. In the case of the Vee or similar types of engines, one long crankshaft is provided to absorb the piston's power and convert it into rotary motion.

Crankthrows are placed at proper intervals along the length of the shaft and at the correct radial position, depending on the number of cylinders in the engine. For instance, in a six cylinder in-line engine two cranks are placed at every 120 degrees around the circumference of the shaft. In this way we obtain correct engine timing.

The shaft is most often forged from tough steel. The torsional strains are tremendous. If these vibrations become synchronized, they will build up to such large proportions that they will break the shaft in short order.

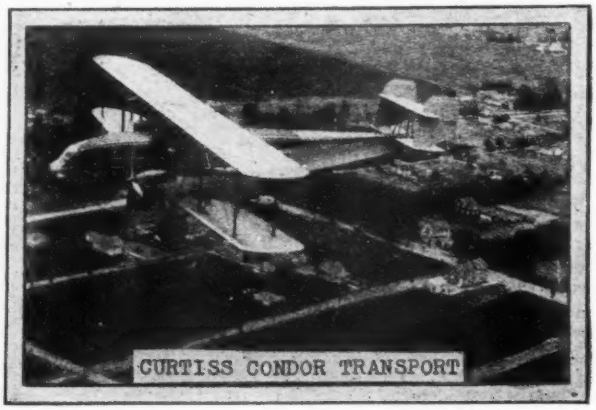
In order to reduce vibration to a minimum, bearings are placed between every crankthrow. This is essential because the airplane is susceptible to the slightest vibration. Further a thrust bearing must be provided perpendicular to the shaft in order to transmit the pull of the propeller to the crankshaft and thence to the framework of the plane.

The crankshaft for radial engines is quite simple. It is very short for it seldom contains over one crank. In some types of construction this shaft is forged similarly to the longer shafts. In the more powerful engines, however, the shaft is made up in two parts. The crankpin which separates the webs is forged on one of the webs.

The two webs are held together through the crankpin by a through bolt. This permits the use of the stronger single-piece master articulated rod. The radial crankshaft has counter balancing weights attached to the webs on the opposite sides from the crank. This tends to reduce vibration somewhat.

All types of crankshafts are drilled hollow to reduce the weight. It is well known that a hollow shaft is stronger than a similar solid shaft having the same weight. Advantage is taken of this channel to send oil through it to the main bearings.

We have now studied the main moving parts of the airplane engine. It becomes necessary to connect these parts to the engine foundation. The crankcase serves as this framework. Its primary purpose is to afford rigidity to the entire engine. It is the base to which are attached the cylinders.



A familiar sight on the large U. S. Air Routes, a Curtiss Condor

It supports the crankshaft and provides a means of attaching the plane to the fuselage.

Particularly, it must withstand the tension caused by the firing cylinders. As the fuel charge is ignited the resulting pressure tends to push the cylinder head away from its base. Since the cylinder is bolted to the crankcase, this combustion pressure places an enormous tensional stress upon the crankcase. One successful method of eliminating this difficulty has been to use a through bolt to secure the cylinder to the main bearing. Thus the strain does not come on the crankcase.

Aluminum alloys are invariably used in the construction of crankcases. This material has entirely replaced cast iron which was formerly used. It is just as strong and has only one-third the weight of cast iron.

The crankcase may be divided in a horizontal plane through the main bearing. Thus, the two halves support equally these bearings; or, the bearings may be placed entirely in the upper half. In this case, the lower half of the crankcase is generally only a light covering to prevent the escape of lubricating oil and to protect the internal parts of the engine from dust and dirt.

Crankcases of water-cooled engines are divided in two types: the wet sump, and the dry sump. The former is used entirely in automobile engines. Here the entire oil supply is carried in the lower part of the case. This aids in lubrication by the splash system and is a simple way to carry the oil supply. This system is no longer used in airplane engines.

The dry sump method is used exclusively. Here, a scavenging pump drains the crankcase of its collected oil and sends it to an external oil tank. In this way an airplane can perform inverted maneuvers without flooding its engine with oil.

The crankcases for radial engines are the simplest to construct. They consist merely of a large cylindrical main section to which the cylinder bases are mounted. These crankcases are made in two sections of duralumin forgings held together by clamp bolts between each cylinder. Each section contains one of the main bearings. Mounted forward or aft of the crankcase are the various accessories and induction chambers.

A brief review of the mechanics of the engine is now in order. The piston traveling downward draws in a charge of fuel through the open intake valve. On the upward stroke this charge is compressed. Ignition occurs. The expanding gases push the piston downward. By means of the articulated rods this power is transmitted to a crank on the crankshaft giving it a revolving motion.

The crankshaft, in turn, rotates the propeller which is keyed to it. On the second upward stroke of the piston the exhaust valve is opened and the burnt gases are driven out to the atmosphere. This cycle then repeats itself continuously.

We know that it takes two complete strokes of the piston in order to give us one power stroke. That is, if we had a single cylinder engine our crankshaft would revolve twice for each power stroke. In other words, sufficient power would have to be transmitted during the power stroke to keep the engine running during the idle revolution.

Thus, our engine would speed up under the impetus of the power stroke and gradually slow down as the inertia of the revolving parts was lost. Our engine would be very rough and impractical for normal usage. This situation would be alleviated by securing a heavy fly-wheel to the crankshaft. The inertia transmitted through this fly-wheel would be sufficient to keep the engine turning at a fairly average rate of speed.

This problem could also be solved by adding more cylinders to our engine, thus getting a power stroke at more frequent intervals. An engine of six cylinders, or a multiple of six, is considered to have the best balance. In the airplane engine, the fly-wheel is unnecessary because of the fly-wheel effect given by the propeller. The fly-wheel is necessary on the automobile but it would be useless weight on the airplane.

The rotary engine closely resembles the radial type in appearance. Its action, however, is quite different. It has a single throw crankshaft which is stationary. The engine itself revolves around the crankshaft. The propeller is mounted to the crankcase and thus revolves with the engine. The fuel charge was admitted into the crankcase and from there forced into the cylinder through ports in the wall.

Since the fuel and the lubricating oil came into such close contact it was necessary to use an oil which would not absorb the gasoline. For this reason a vegetable oil, castor, was used. The fumes from this good old childhood remedy caused distress to many a hardy pilot.

This revolving mass in the nose of an airplane created a tremendous gyroscopic effect. This was sufficient to make climbing turns with this type of engine extremely hazardous. Spins frequently resulted. The resistance created by the revolving engine was great, and prevented its use in the production of higher horsepowers. The rotary engine is now obsolete, and there are no indications that it will ever come into use in the future.

The working pressures inside the cylinder can best be understood by studying an indicator diagram. The inlet valve opens at A (see figure 1), the piston travels downward to B, creating a negative pressure or vacuum. It is seen that this line is below the atmospheric pressure line. From B the piston now travels upward, building up compression as it goes. Combustion begins at the point of ignition, and the pressure within the cylinder rises quickly to its maximum at C.

As the piston travels downward, more space becomes available to the gases and they expand, thus losing their pressure gradually. The exhaust valve opens at D shortly before the piston reaches its bottom dead centre, and the burnt gases begin to escape. At E the piston again moves upward, pushing the remainder of the gases out and reducing the cylinder pressure to zero as it reaches top dead centre at A.

The third article will deal with the carburetor, fuels, and fuel systems. It will be a detailed discussion of the carburetor and the theory of carburetion.

UDET

(Continued from page 20)

up almost on a level with Udet, and roaring straight at him.

Udet kept his course, thinking his opponent would swerve. This time the maneuver did not work—usually the man who swerved was raked with gun-fire by the other. However, this Englishman also held to his course. Neither would yield. Shooting wildly, they came together with a terrific rending. Udet was tossed about by the impact, and saw the English plane break clear and fall toward earth. The wheels of the German machine had smashed the other's wings, but in spite of this, the English plane leveled off and landed, totally wrecked. Udet also landed, though with much uncertainty, not knowing whether his undercarriage would hold or not.

Udet had many miraculous escapes. Once three English Sopwiths forced him down to about three thousand meters, where he leveled off and found that his guns were jammed, his windshield gone, and his gas tanks pouring gasoline into his lap. He shut off the spark and started a glide to his base. He barely scraped over the buildings at his field, but could not turn into the wind, and had to land with a breeze on his tail. The crash tipped his Albatross over on top of him.

Once, forced to land while confused in a fog, he found that he had landed on British territory! British soldiers started for him, but did not realize he was a German till Udet suddenly took off again. He "hedgehopped" almost over their heads, with their bullets pinging through his wings. Clearing a group of huts, he knocked off a tin smoke-stack with his undercarriage.

By this time machine-gun bullets sang all around him. But he staggered over a group of trees and landed inside his own lines—with a dead motor!

Udet's largest day brought him four victories. All through the final months he fought with von Richthofen's famous Jagdstaffel, as coveted an honor as for a Frenchman to fly with Fonck's Cigognes. He was the only ace of Germany's five premier aces to emerge from the war alive.

Unlike most war pilots, Udet continued stunt flying after the war, and today at the age of thirty-three he is one of the daredevils of the motion pictures.

Tandem Model

(*Continued from page* 10)

and **5** use eight pieces, all different lengths as shown clearly in the drawings. For fuselage end piece use a 1/32" square balsa strip **6.**

From a piece of soft balsa form the noseblock **7,** drill this for the propeller shaft as shown in drawings. Prepare the motor stick **14** from 5/32" x 3/32" hard balsa strip and glue one end to the noseblock. The other end of the motor stick must be glued in the bulkhead **IV**, but before this, glue the rear hook in the motor stick and also one conventional Can **28.** The nose block in front is glued to the longerons **2.**

Prepare from 1/32" square balsa wood two pieces each of **8, 9** and **10,** and one piece of **11.** With these form the cockpit and the fuselage nose top parts. Glue one piece of balsa strip **12** between the longerons **2,** and two pieces of **13** to the end of the fuselage—one between the longerons **1** and the other between the longerons **2.**

From bamboo strips **16** and **17** form the tailskid and use a balsa brace **15** to strengthen these as shown in the drawing. The fuselage skeleton is now ready.

Prepare from 6" x ¾" x ½" soft balsa blocks the propeller, shown in Fig. V. Fix in nose block **7** an eyelet. Make a conventional shaft and fix the propeller as usual, not forgetting to use washers. Hang two loops of rubber band, .045 square, on the hooks, and that finishes the inside of the fuselage.

Cover the cockpit and the cabin windows with cellophane and the other parts of the fuselage with thin covering paper.

Next, make the elevator as shown in Fig. V. Parts **25** and **26** are balsa, and **27** is bamboo. All these are 1/32" square. Cover the top only and glue them to the fuselage, as shown in Fig. 2. Make the rudder (see Fig. 2), using 1/32" square bamboo for this work. When finished, cover both sides.

Make two pieces each of **18, 19** and **20,** using 1/32" bamboo for this work. With these six pieces of bamboo, form the landing gears as shown in drawings 1 and 2. Fix the two axles to the landing gears in the usual way and use two 1¼" diameter wheels.

In Fig. 5, are the drawings of the airfoils, N.A.C.A. M-15. Cut 21 ribs from 1/32" balsa sheet. Prepare two pieces of 1/16" square balsa strips for leading edge **22;** two pieces 1/16" x 1/32" balsa strips for trailing edge **23,** and two 1/32" square strips for top-spar **24.**

Construct the two wings with these materials, as shown in Fig. 4. In the drawing only one-half of the wing is shown. If you will notice, the front wing has no dihedral, but the rear wing has ¾". Your attention is also called to the fact that the rear wing is built of eleven ribs, because it has a center rib. The front wing is built of ten ribs only.

In Fig. 3 you will find the wing tip **21,** made of 1/32" square bamboo. Form four pieces of these and glue them to the wing tips. Now the wings are ready for covering. Cover them on the both sides.

Next, fasten the wings to the fuselage. As shown in Fig. 2, the front wing is glued to the top of the fuselage, which gives it zero degree of angle of attack. From 1/16" balsa sheet cut out a form **29** (see Fig. 2), and glue to the top of the fuselage. This piece assures you of a 6 degree angle of attack for the rear wing.

Glue the rear wing (which has dihedral) to this holder **29.**

Be careful, that the leading edge of the rear wing is one inch from the trailing edge of the front wing.

Now your model is ready for the test flights.

Radio Course

(*Continued from page* 17)

transmitting electrical power over long distances will use a high voltage; 50,000 or 60,000 volts and step it down by means of step-down transformers at various points along the line where it is needed. In this manner, a vast saving in copper wire is effected.

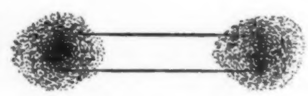


FIG. 4 FILINGS ADHERING TO MAGNET

Frequency

The frequency of an alternating generator will be found by multiplying the number of its revolutions per second by the number of its field poles and dividing the result by two. This will also represent the number of cycles. A kilocycle is 1,000 cycles.

Alternators for ordinary commercial use will have a frequency ranging from 60 to

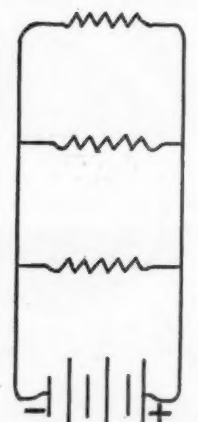


FIGURE 2 - RESISTANCE COILS IN PARALLEL

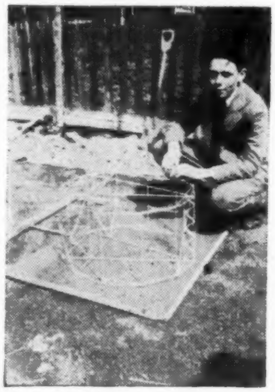
600 and these are called low frequencies. Radio work requires frequencies ranging from 10,000 cycles per second onward. These are named high frequencies.

Next month we will deal with the direct current generator and the electric motor.

American Sky Cadets

(Continued from page 19)

shops, the engines have been picked up at various times, put together and set up by the classes. An instruction plane used by the club is "home made." Nothing has been done which is beyond the reach of the ordinary group of boys under proper instructors. The secret of the success of this club seems to be in the interest and co-operation given by the Principal and Faculty. Facilities have been offered by the authorities, competent instruction has been given, a proper course has been mapped out and the interest sustained.



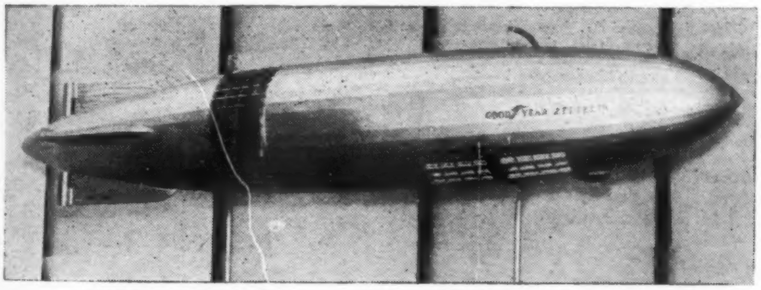
Philip Meehan, student at A. R. L.

Each instructor while giving the general course to his group is a specialist in his own line as follows:

M. M. Peake—Theory, opportunities, guidance.
T. F. Kinney—Models.
R. R. Schoonoven—Meterology.
H. Murphy—Radio.
D. Sousa—Theory, vocational training.
Miss C. Sauer—Girls.

A new division, separate from the club but yet a part of the aviation instruction has recently been formed under the direction of Messrs. Peake and Sousa. This division is known as Vocational Guidance.

The purpose of this course is to use aviation in order to bring out the best in a boy. He is brought to realize that this field calls for high standards morally, mentally and physically. The course itself deals with aviation in a purely theoretical light. It teaches him what aviation is and what fields in aviation are open for his own natural talents.



A 10 foot model of the Navy dirigible, ZRS-4, displayed at Stern's

Questionnaires are set at the beginning of the course, the purpose of which are to try and discover what the boy is looking forward to, what line in aviation he desires to take up, what he knows about it—and how well he knows himself.

He is graded by the instructor according to his knowledge and asked to grade himself in reference to his own attainments. Strange to say most boys give themselves a much lower rating than the instructors would give them. At the end of the course a similar questionnaire is given and a comparison made with the first one. Those showing aptitude are then passed on to the club for the aviation course.

This club has proved that aviation can be used as an educational feature by schools. The instructors and faculty at Lafayette have used the club not so much to make better aviators but to make better boys. The purpose the faculty had in view was education in its broad and real sense. That the boys themselves co-operated is shown by the crest they themselves invented and adopted, setting for themselves a high standard of Honesty, Knowledge, Health, Courage and Friendships.

The club formed four years ago as an experiment has proved its value and is today the model for aviation clubs throughout the country.

JERSEY CITY CONTEST

IN the presence of Ruth Roland, screen star aviation enthusiast, Clarence Chamberlin, famous Trans-Atlantic airman, Edwin B. Lord, vice-president of the Jersey City Chamber of Commerce, and others, and cheered at frequent intervals by a gallery of more than 500 classmates and friends, 200 pupils of various grammar and high schools of Jersey City, recently competed in the model plane contests, sponsored by Loew's, with the co-operation of the Department of Manual and Industrial Training of the Board of Education, and the Sport Shop, of 14 Journal Square.

The contests—there were eight—got under way promptly at 3:45 with the arrival of Miss Roland and Chamberlin.

The contests in class "A," open to boys in grammar schools, were the first to be called. These and the winners were:

1. Best flying airplane, 13-inch wing spread or less. Winner—Frank Ehling, P. S. 8. Plane aloft 20 seconds.

2. Best flying airplane, 13-inch wing spread or more. Winner—Robert Bleecker, P. S. 28, plane aloft 28 seconds.

3. Best flying all-balsa plane—to rise off ground. Winner—James Kopysinski, P. S. 6.

4. Best flying cabin plane—to rise off ground. Winner—Woodrow Kolling, P. S. 6.

5. Finest non-flying scale model. Winner—Howard Killener, P. S. 6.

Winning contests in class "B," open to pupils of the high schools were as follows:

1. Best flying airplane, 13-inch wing spread or less. Winner—George Allen, Dickinson. Plane aloft 22 seconds.

2. Best flying airplane, 13-inch wing spread or more. Winner—Philip Meehan Dickinson. Plane aloft two minutes.

3. Finest scale model. Winner—H. Randall, Lincoln High.

Each of the winners received an "Aviation medal," presented by Loew's, through the co-operation of the Sport Shop. In addition, twenty-five boys were awarded honorable mention.

Miss Roland was one of the judges in the flying model contests.

Entered in the contest were miniature replicas of some of the best known models such as the Yankee Doodle, the Dornier DO-X, Boeings, Gothas, Autogyros, twelve-passenger cabin planes, giant bombers and DH-Moths.

The winners of the scale model contests were the most difficult to select. Clarence Chamberlin, after much difficulty, finally selected two winners, and because of the many other fine entries also selected ten more boys, runners-up in these two competitions, who were his guests on a flight over Jersey City and environs. Among these boys were D. Bendix, F. Wolfong, J. Potrosie and I. Mills of Dickinson and V. Iwanowski.

THOMAS JEFFERSON CLUB

THE Jefferson Aviation Club at the Thomas Jefferson High School, Elizabeth, New Jersey, was organized in October, 1930, under the leadership of Mr. Voss. The officers appointed are Poi Levett, president and also representative of the Jefferson Student Organization, Elliot Heilbrun, vice-president and Fred K. Boller, secretary-treasurer.

The officers are elected semi-annually and meetings are held each Tuesday during the third period—this time being set apart by the school authorities for club activities.

Although the club is young, considerable progress has been made. Models constructed by some of the twenty-five members have been on display in the school library while the meetings have been devoted to a study of aviation and discussions by the members of current events in the aviation world.

A two-days' carnival was held at the school recently in order to raise funds for the purpose of buying uniforms for the band —which is one of the finest school bands in the state. The carnival was a great success.

Schoolrooms were converted into show rooms for this purpose and contained exhibitions of the pupils' many activities. The model plane exhibit was, as usual, a feature which attracted great interest. Outstanding models were a Curtiss *Condor*, built by K. Leroy Griffin, and a Cierva *Autogyro*, the handiwork of Phil Jaeger.

Rene Fonck

(Continued from page **14)**

The registering paper on the barograph showed a vertical stroke of ink crashing down, tapering away at 5,000 feet and showing the crash as the German struck the earth. Strangely enough, the delicate barograph was undamaged.

Guynemer at this time was the French idol, and was thought invincible. However, the German pilot Wisseman brought Guynemer down on September 11, 1917, and felt so self-confident after that victory that he wrote home he had nothing more to fear in aerial warfare . . . but that was before he met Fonck.

Nineteen days after Guynemer had been lost, Fonck met his slayer in the upper fighting world. Far above the clouds, nearly five miles up, Fonck's Spad whirled itself at Wisseman's Rumpler. The Spad was lighter, and Fonck was able to outmaneuver his heavier antagonist in the thin air of 24,000 feet altitude.

Swooping around behind the Rumpler, Fonck fired a burst of six machine-gun bullets. He aimed directly into the enemy's tail. The observer was shot, and suddenly was hurled from the machine as it turned over. His hurtling body, on its fall of miles toward the invisible earth, passed close to Fonck's plane.

The Rumpler itself, disabled and out of control, fell directly through Fonck's patrol far below—its wings grazing one of them as it whirled downward to destruction. The confident Wisseman had met his master, and Guynemer was avenged.

In spite of bad weather during October, 1917, permitting only thirteen and a half hours of flying, Fonck shot down ten enemies. He was credited with only four, the others falling out of sight of witnesses.

On May 8, 1918, he brought down three enemies with a total of only twenty-six shots. That afternoon he destroyed three more with only thirty bullets!

On September 26, Fonck, now 1st Lieutenant, shot down six Germans within two hours, near Montdidier. In his first combat of less than five minutes, he got two in the first ten seconds! He returned to his airdrome for an hour, then went out to the same region, shot down an artillery observer, then attacked a patrol of four Pfalz fighters, and picked off two of them in a few minutes.

Fonck was probably the greatest of aerial strategists. His coolness and tactical skill carried him through unscathed. He had two or three combats with the great von Richthofen himself, all ending in a draw. His methods were in direct contrast to Guynemer, who plunged headlong into battle and won by dash. Guynemer was eight times downed, had many shattered planes, and finally lost his life. Fonck was cool and invincible.

The Ace of Aces was with the famous Cigognes, greatest of French squadrons, when the war ended. In three months with this group he shot down twenty-four enemies.

Fonck never flew unless he felt in perfect condition. He kept in the best of health, used no alcohol and trained for his battles as for an athletic contest. With a cool head and a brain that was fast and accurate, he became the greatest fighter of them all—for he emerged from the war with his life and health.

The Aviation Advisory Board

(Continued from page 25)

A feature of the "Pup" was the window panels in the upper plane. The windows were rendered necessary by the fact that the pilot sat with his head below the level of the plane. A single machine gun firing through the propeller was mounted above the fuselage.

The "Pup" (Sea-type): When starting from and alighting on the deck of a ship became the fashion, the Sopwith "Pup" was modified slightly for this purpose, and good work was done by this type on the North Sea patrols, for which work it proved very suitable. This machine did not differ greatly from the standard type.

The Sopwith Triplane (May 28, 1916): Amongst all the Sopwith productions, nearly all of which attained great fame—so much so, indeed, that their type names were veritably household words—none was more characteristic than the triplane, affectionately known as the "Tripe" or "Tripehound." This machine was fitted with 130 h.p. Clerget engines.

The principal objects aimed at in this notable design were, first, the attainment of a high degree of visibility, or, rather, the reduction to a minimum of the pilot's blind angle. With his head on a level with the intermediate plane, he enjoyed a practically unrestricted arc of vision through about 120°, while sections cut out of the centre of the intermediate plane enabled him to have a good view of the ground when landing, the position of the cockpit being such that the bottom plane had no restricting influence on the view. The narrowness of the chord made available by the use of three main planes also allowed the pilot an exceptional view upwards and to either side, an important consideration in a purely offensive machine.

The second object aimed at was an increase in maneuverability, and the triplane principle was adopted to secure this purpose in consequence of the fact that, owing to the narrow chord, the shift of the centre of pressure with varying angles of incidence was relatively smaller than in a biplane, and consequently demanded a shorter length of fuselage to carry the tail. At the same time the small span reduced the moments of inertia in the horizontal plane and a machine was thus obtained which was highly responsive to its controls and which could add the important ability to dodge to its other strategic advantages. The consideration of movement of the centre of pressure enabled single I-struts to be adopted in place of the usual pairs springing one from each spar. This construction also led to a sensible simplification of the wiring system. Ailerons of the unbalanced type were fitted to all three planes.

The Sopwith "Camel" (December 22, 1916): Few airplanes did more to repulse German attempts at aerial supremacy than the famous "Camel," so called from the hump

See page 3 of this issue for full details.

which it carried on the forward top side of its fuselage by virtue of the fitting of two fixed machine guns, both firing through the propeller. Furnished with a 130 h.p. Clerget and designed to achieve a very high performance both in climb and speed, the "Camel" showed itself a redoubtable fighter against antagonistic scouts, and also performed extraordinarily well as a Zeppelin catcher, in which latter connection its ability to climb with great rapidity was extremely valuable.

A good angle of vision was obtained by keeping the pilot fairly well forward, and also by the positive stagger of the planes. In place of the large transparent panels fitted into the middle of the top plane in the "Pup," that of the "Camel" was provided with a faired-off slot. The remainder of the design followed "Pup" lines pretty closely, but it is of interest to note that this machine was the first to be fitted with two machine guns, a practice that was later extensively adopted in both Allied and enemy airplanes of a similar type.

The Sopwith "Camel" (Sea-type): This design was almost identical with the above, except that the fuselage was made detachable at the rear of the pilot's seat, enabling the machine to be conveniently stowed aboard ship. It was used for flying from the deck of seaplane carriers, and, in addition to this, was also carried on some fast cruisers. The method of launching was off the Barbet guns, and it required a machine of considerable efficiency to get off with certainty and satisfaction with so short a run.

The Sopwith "Snipe" (March 17, 1917): This machine was produced primarily with a view to the attainment of a very high performance and exhibited characteristics of both the "Camel" and "Dolphin." From the latter it differed in point of stagger and plane dimensions, and also in having a 200 h.p. B. R. engine in place of the Hispano-Suiza. As in the "Dolphin," the rudder was of large size and balanced, and the "Snipe" as might be expected from its general lines and arrangements of weights, was highly maneuverable. The pilot's head, owing to the deep fuselage and small gap, was on a level with the top plane, the centre of which was partly cut away and partly slotted. A double-bay system of struts was used, giving, with the relatively small span, great constructional strength. Owing to the large diameter of the B. R. 2, the rectangularity of the fuselage only appeared towards the tail, and the body was more pronouncedly circular than in previous Sopwith designs.

The "Snipe" did not make its appearance until well on in the middle of 1918, and had thus very little chance of introducing its qualities to the German Flying Corps. In the short time at its disposal, however, it made an enviable reputation for itself. In four days a single "Snipe" squadron accounted for thirty-six enemy airplanes, and downed thirteen in one day. An outstanding feat was that performed by Major Barker, who, in a Sopwith "Snipe," when attacked by sixty hostile machines, crashed four of them and drove down no less than ten out of control.

In addition, it might be mentioned that a "Snipe" fitted with an A. B. C. engine attained a speed of 156 m.p.h., and climbed to 10,000 ft. in 4½ minutes.

The Sopwith "Dolphin" (May 23, 1917): Two principal objects were borne in mind in the design of this single-seater fighter—firstly, to make good use of the 200 h.p. Hispano-Suiza engine (which had reached a productive stage) and, secondly, to afford the pilot a range of vision greater than that of any other existing airplane. The former necessitated a departure from the usual lines of the Sopwith fuselage, the upper surface of which in the rear of the cockpit was more pronouncedly arched than in previous types. The span of the planes was increased beyond that of the "Camel," and a double-bay arrangement of struts adopted in order to provide great structural strength. At the same time the gap was slightly diminished, and, what formed a strong characteristic of the type, a negative stagger was adopted, with the object of placing the main spar extensions of the top plane in such a position as not to interfere with the complete freedom of movement of the pilot, who occupied the rectangular space formed by them.

On these tubular steel spar extensions—which were supported by four short vertical struts from the fuselage—were mounted two Lewis guns, capable of being aimed independently of the direction of the machine. Two fixed Vickers' guns firing through the propeller were arranged along the top of the engine, and were partially covered in by this cylinder fairing. The general arrangement of the front part of the fuselage was particularly neat, and its formidable appearance was well supported by the "Dolphin's" offensive capabilities. The radiator was divided in two portions, each carried on one side of the fuselage level with the pilot's cockpit. In front of each radiator was arranged an inclined and adjustable deflector, allowing the whole or any part of the cooling surface to be obstructed. Among other features of the "Dolphin" was an empennage design differing markedly from that of previous Sopwith types. The fin was of a more upright shape and the rudder was balanced.

The 300 h.p. "Dolphin": In connection with this type it is of considerable interest to note that at the signing of the Armistice it was being built in quantities by the French Government, for themselves and the American Government in France. It was fitted with the 300 h.p. Hispano-Suiza, and an adjustable tail plane was employed, since the variable load was considerable, the French and American Governments calling for a very large quantity of gasoline to be carried. The machine was reinforced in certain respects to allow for the considerable addition of power. In general outline it was very similar to the 200 h.p. Hispano-Suiza "Dolphin." The guns were completely concealed under the cowling, being fitted in tunnels, and the air intake of the carburetor was fitted with a telescopic-type gas tube direct into the front cowl, considerably diminishing the risk of carburetor fire.

The Sopwith "Cuckoo" (June 6, 1917): There is genuine humor in all the Sopwith type-names, and in none more so than in the "Cuckoo," which was encouraged to lay a very splendid egg in any enemy nest that could be located above the surface of the

sea. The egg in this case was a special 18-inch torpedo, which the "Cuckoo" carried strung underneath her fuselage and between the wheels of the landing carriage, which consisted of two independent wheels, each separately mounted, and not, as was then usual, united by a common or articulated axle.

This machine was built at the request of Commander Murray Sueter, R.N., and was of considerable dimensions. The treble-bay arrangement of struts and also the installation of the 200 h.p. Hispano-Suiza geared engine, with the elliptical radiator surrounding the propeller shaft were noteworthy.

The "Buffalo" (February 19, 1918): This machine, fitted with a B. R. 200 h.p. engine, was designed primarily for reconnaissance and contact patrol work, with a view to armouring the pilot, observer and fuel tanks against enemy attack. The construction of the fore part of the fuselage was similar to the "Salamander." It was fitted with one synchronized gun firing forward and one Lewis gun on a Scarfe ring mounting firing aft. The experiments with this machine were highly successful, and it was on the point of being put into quantity production when the Armistice was signed.

The "Salamander" (April 26, 1918): In general lines this airplane was modelled after its prototype, the "Snipe", but its function was of a totally different character. It was designed primarily as a trench fighter, for which purpose it was armed with two fixed machine guns and protected with armour plating. The latter formed the front of the fuselage from a point immediately in the rear of the engine (a B. R. of 200 h.p.) and extended to the rear of the pilot's cockpit. This plating was not added to an existing frame, but had a structural as well as a protective function, and itself formed the front portion of the fuselage. The faired cowling behind the engine was added above he armour. A small variation from "Snipe" detail was in the tapering spine serving to fair off the pilot's head. This, being bulletproof, gave him a considerable means of protection against attack from the rear. The total weight of the armour was 650 lbs., and, in addition to this extra load, 2,000 rounds of ammunition were carried for the guns.

(The date against each machine is that on which the machine was passed by the Sopwith Experimental Department.)

The Airistocrat Model

(*Continued from page 27*)

carriage is of an extraordinary type, incorporating the truss system of construction used on the large Airistocrats by the General Aircraft Corporation. The landing gear on our model contains a neat, compact, and effective shock absorbing system. The advantage in using this shock absorber on your model is that it saves the members around the vicinity of the undercarriage from the usual severe stresses encountered in landings.

The landing gears are made from 1/16" x 1/16" white holly, and 1/16" flat balsa

for formers to streamline the landing gear. Cut your strips to the correct size as shown on drawing No. 1. Start with the front triangle A. Lay the pieces required for the front triangle in a jig, making sure that each member rests flush against the other.

Cement them in place and proceed to make your wire bearings, shock thimbles, pins, and axle, all of which are given in the drawings. Now that the wire fittings are made, the front triangle should be dry. Cement the intermediate members, and the landing gear is ready for covering. Cover it with Japanese tissue and give it three coats of dope.

To attach to fuselage, align the bearings of the landing to those of the fuselage and slip the pins through the bearings. Make the pins secure so that they may not be withdrawn from the bearings, by bending the protruding ends. Set up landing and thimbles as shown in drawing 4 and wind three turns of 1/8" flat rubber around the shock thimbles.

Now place the wheels on the axles, and put a small drop of cement at the ends of the axles to keep the wheels from rolling off. This completes the landing gear. The completed landing gear should not weigh more than .20 ounce.

WINGS

To make the centersection select your wood and cut to size as shown in drawing 4. This material consists of 1/16" holly for spars and 1/16" flat balsa for ribs. Slip the spars in place according to drawing 4. (Note that the spars run directly through the fuselage.)

At this stage of construction, cover the fuselage. The paper is merely slitted and slipped over the centersection spars. Cut ten ribs accurately and cement them in place, setting them between spars a and b. Proceed by inserting your truss and pin blocks as shown in wing spar drawings.

The next step is to construct the wings in which the spars are built up in the same manner as described in the centersection. There are ten ribs and six false ribs required for the wings. The tips are made from 1/8" x 1/8" balsa and sanded down to a smooth finish. Be sure to place the wings on a flat board. The leading edge is made from 1/8" x 1/16" white holly or spruce, and the trailing edge from 1/16" x 1/16" white holly or spruce.

When the wings are thoroughly dry we are ready for covering. Either superfine or Japanese tissue may be used to cover the wings. A good proportion for dope for the wings is three parts of acetone to one part of banana. The final coat can be mixed with analine dye.

The next step in completing the wing structure is to build our struts. There are four required, the front struts being 1/16" longer than the rear. They are made from 1/8" x 3/8" balsa and given a streamlined cross-section. Proceed by inserting your strut fittings. The structure including the centersection and struts should not weigh more than .40 ounce.

TAIL ASSEMBLY

The horizontal stabilizer is made in two parts, as shown in drawing 3. The spars are made from 1/16" x 1/16" white holly or spruce. The outline is made from 1/16" x 1/32", bent over a candle flame, and the ribs are made from 1/32" square bamboo. The tail is made by bending the ribs around the spars, and later inserting your outline. The tail is then placed one-quarter above the thrust line at 0° incidence. The rudder is made in the same manner as shown in drawing 5A. The proportion for the dope on the tail is five parts acetone and one part banana oil.

The propeller and the tail remain to complete the model. The propeller and its fittings are shown in drawing 9. Great care should be taken in covering the propeller. The blades at the tips need not be thicker than 3/32", and not less than 3/16" at the hub. Balance the propeller carefully, and insert the shaft. Eight strands of 1/8" flat rubber are used. The completed model should not weigh more than 3/5 ounce.

The model flies fast. Glide it first when there is little wind. Wind it up about one hundred turns by hand and launch it with the wind. The model will soar away beautifully. Now for a big flight. Detach the motor stick. Have someone hold the propeller. Hook the "S" hook in the winder and stretch the motor about two and a half times to normal length. It can be wound smoothly about three hundred turns. Hand launch it in level flight with the wind. You will be surprised at its beautiful flight. It can be made to take off under its own power. Just wind it up fully and set it on a smooth surface where it can run from three to five feet.

NECESSARY MATERIALS

2 pieces 1/8" x 1/8" balsa
1 piece 1/8" x 1/4" x 18" spruce or white pine
10 pieces 1/16" x 1/16" x 36" white holly
1 strip 1/8" x 1/8" balsa
3 pieces 1/16" x 2" x 36" balsa
4 pieces bamboo
1 piece 1/16" x 1/8" white holly or spruce
1 block 8 1/2" x 1/2" x 1 1/4" balsa
2 feet No. .032 piano wire
2 feet No. 8 piano wire
1 foot No. .020 piano wire
1 cap washer
1 flat washer
1 large size propeller bearing
1 two-ounce can banana oil
1 two-ounce can acetone
1 two-ounce can ambroid (or 1 large tube of cement)
1 pair two-inch celluloid wheels
1 sheet transparent cellophane paper
3 sheets Japanese super-fine tissue
12 feet 1/8" flat rubber
1 spool silk thread
1 small camel hair brush.

Course in Airplane Designing

(*Continued from page 26*)

shape, has not enough volume to support much excess weight.

As a result, the stern "digs under," forced by the weight of the plane and the backward motion. As soon as this happens the plane rears up still further, and, in a moment or two, our proud ship of the sky is upside-down under the water, with only the pontoon bottom showing above the surface.

Going into the matter further, we will try to find out just what caused the above flip-flop. I have said that the float had lots of buoyancy forward but not enough toward the stern. That's just it. The stern portion, because of its streamline taper, has not enough volume to displace the amount of water necessary for its share of buoyancy. The longitudinal stability of the float is bad (I mean, of course, stability while in the water).

Thus we see that a float, while it may appear a sound design from an aerodynamical point of view, must be designed also as a good boat. Our sketch in Figure 1 is, of course, exaggerated, the object being to show how *not* to design a pontoon rather than to show a practical float. The one shown in side view in Figure 2 is a successful float. The top view of this float would show the stern portion much wider than that of the other, the long, tapering lines being absent.

As for the float in Figure 1, we might call the difficulty bad "distribution of buoyancy" and not be far from the mark. We might say, also, that the *center of buoyancy* is too far forward in the float. This last is the way an aeronautical engineer would put it.

The term, *center of buoyancy*, is a hard one to define. Like *center of gravity* and *center of pressure*, the C.B., as it is called, is not something that we can put our finger on and say, "This is it." We know that it is there, and we can locate it precisely by mathematical processes too complicated to detail here; but we find it hard to define.

Let us try it, however. We know that the center of gravity of an airplane is the point at which the whole ship would balance if its weight could be supported at that point; say, on a very small steel rod. Now, for pontoons, we can define the *center of buoyancy* by the same method, saying that it *is the point at which the entire normal load of the pontoon may be applied, with the pontoon still riding at normal trim.*

"Normal trim" is a new term, so for the present we will just say that the pontoon will ride as it normally does with the weight of the plane pressing down on it through the attachment struts. That is, neither the bow nor the stern will be any lower or higher in the water than normally.

That definition is as simple as I can make it for our present purpose. The technical definition goes like this: "*The center of buoyancy of a float is the center of gravity of the displaced water.*" But that seems a little hazy for model work. The principle of the thing, however, is precisely the same in either case. Take another look at the first definition, and, if possible, experiment with a model pontoon; and I think the point will be cleared up.

However, all that is rather vague. Let us try to get down to cases. Suppose we have a model pontoon of the standard vee-bottom type. How can we find the center

of buoyancy? Remembering that first definition, and also our practical method of finding the center of gravity of a model plane, we can do the trick in a moment or two.

Just place the float in water and press down on it with a dull-edged knife, using about the same pressure as the weight of the plane. By experimenting we can easily find the point at which the pontoon rides as we wish it to—that is, at normal trim. This method, like the first definition for C.B., is thoroughly practical, and it is obvious that the center of buoyancy of the float is at the point where the knife-edge is applied when the float rides at normal trim.

There is a precise mathematical method of finding the center of buoyancy of any float, but the long and involved discussion necessary to explain the method would be out of place in this course.

So far, then, we have learned that a pontoon or float must have its volume, and hence its buoyancy, distributed fore-and-aft, so that it will possess enough longitudinal stability to float the plane safely on the water. The C.B. is, of course, located by the shape of the float.

For example, a float like that shown in Figure 1, having a great deal of volume up forward and very little aft, would have its center of buoyancy well toward the front. Now, by re-designing this float and increasing the volume aft, we could move the center of buoyancy toward the stern, thus getting sufficient floatation in the after-portion to keep the airplane from tipping over backward.

When fitting pontoons to a plane it is well to keep in mind that the C.B. of the float system should always be forward of the center of gravity of the plane. In other words, the float or floats, if of the scale model type, should trim slightly by the stern, like the one shown in Figure 2, having the stern lower in the water than the bow.

It is plain that all seaplane floats should have a reserve, or excess, of buoyancy. Suppose we had a gasoline-driven model airplane which weighed exactly 62.5 pounds. This would, of course, be rather a large model airplane, but it serves our purpose. We know, from last month's article in this course, that one cubic foot of water weighs 62.5 pounds.

Then, a float for our gasoline-driven model must displace—*at the very least*—62.5 pounds of water, or one cubic foot, to put it in terms of volume. A float of this volume would support the plane on the water; but, were one ounce of extra weight to be added, the pontoon would promptly sink.

Since extra weight is often thrown on the float, particularly in landings, we design all pontoons with reserve buoyancy—usually from 70 to 100 per cent in full-size practice. This means that, for a one-hundred-pound airplane model, the float would be capable of supporting from 170 to 200 pounds without sinking.

For model airplane floats, the matter of reserve buoyancy is rather a moot point. Some builders stick to the policy of making the floats only as large as absolutely necessary, trying to keep down both weight and drag by keeping down the size. Others make their pontoons quite a bit larger, claiming that it is better to build a light, well-designed pontoon of generous proportions than to build a small one and run the risk of losing one's plane.

There is this about it, a model seaplane is often capsized on landing, particularly if the water is a little rough and the wind is gusty; and, once capsized, the model is extremely hard to locate. Two or three small pontoons, projecting perhaps half an inch above the surface of the water, are mighty hard to see when one is searching for his plane. Besides, a ducking such as a plane gets in an upset like this invariably ruins the wings and perhaps other parts, due to the soaking-up of water.

Therefore, since a great deal can be done in the matter of air resistance and weight by careful designing, it seems best to build floats with ample reserve buoyancy.

It is important also that the floats shall move through the water easily. Take care to see that the surfaces are smoothly covered.

As for the shape of model airplane pontoons, it is hard indeed to make any definite statement. Each of the many different types of model is suited to its own particular style of float. A flying scale model would undoubtedly look best with floats patterned after those on full size jobs; while the same floats on a twin-prop pusher would be entirely out of place.

The design of model airplane pontoons is a wide and interesting field, with many chances for the clever builder to develop new types of floats that will prove more efficient and much lighter than those now in use. New methods of construction will undoubtedly be developed in this fascinating game of ours.

The quest for new records and better flying performance will inevitably set clever minds to working, continually fighting the battle with weight and drag, searching for new ideas and better methods of construction. And, after all, the flying model seaplane is the most interesting of them all to experiment with.

Try it sometime. Take a model seaplane out on a lake with a rowboat. Make sure that your feet are braced and that you will not take a nose-dive into the water; then set the model on the surface at the stern of the boat. Give it a gentle push. Watch it skim along rapidly, lift clear, and go soaring into the sky! You'll get a whale of a kick out of it. And besides, the exercise of rowing the boat won't do you a bit of harm!

The model airplane is a stepping-stone. The fellow who designs successful flying model seaplanes today will, quite probably, be designing full-size planes before many years have passed, and he will be applying the same principles that he uses today on his models. That is why, in this course, we discuss both models and full-size ships.

Models bridge the gap between theory and practice and enable the observing builder-designer to learn by doing—*the best way!* By understanding the how and why of the thing the model fiend is able to watch his models fly, always figuring out the reasons behind their behavior, to improve their performance; and, last but not by any means least, he gets a sound foundation for future work in the great aircraft industry of tomorrow.

So now we'll get back to full-size airplanes and their pontoons.

With all the intensive research that has been carried on by means of model tests

in the Washington Navy Yard and elsewhere, there still remains one point in float design that puzzles engineers. That is "porpoising." Porpoising is a violent rocking of the float, during which the bow of the float first rises and then dives. It is thought to be caused by the location of the step; but that has not, to my knowledge, been proven satisfactorily.

Two different floats of precisely the same design, mounted on different types of planes, have shown exactly the opposite characteristics in regard to porpoising. That is to say, one of the floats did not porpoise, while the other rocked so badly that the pilot was unable to get the plane off the water. When a float starts porpoising the only thing to do is to close the throttle and stop the plane. No movement of the air controls seems to have any effect.

It is possible that porpoising is caused by a combination of factors which—as in the case of the flat spin until a short time ago—are still obscure and will have to be worked out by scientific research and practical experiments. Since a float which porpoised badly when mounted on one plane behaved quite well when fitted to another, it seems probable that the oscillation is caused by the combination of certain factors in the design of the float coupled with certain other factors in the design of the plane. At any rate, the matter is still an obscure one.

Earlier in this article we spoke of "normal trim." The word "trim" is one used by naval architects (boat designers) to indicate the angle at which a boat or float rests in the water under a load. As shown in Figure 2, the trim is the angle between the horizontal—the waterline—and the deck line of the float. Each boat or float is designed to ride at a certain angle when loaded. This angle, then, is "normal trim." In seaplane float design the expression is a handy one to use, just as "flying position" is used when speaking of the entire plane in the air.

"Trim by the bow," another expression that is often used in this connection, means that the float is riding with the bow lower in the water than normal trim. "Trim by the stern" means that the stern is riding low.

Some very large seaplanes and flying boats, as well as a few smaller ones, use water rudders for control while taxi-ing on the water. Some experts claim that water rudders are dangerous, especially when connected to the air rudder controls, saying that the ship may be landing in a slight cross-wind and the setting for water rudders will differ from that of air rudders.

Since large seaplanes are rather hard to control in taxi-ing, however, water rudders are often used. Generally they are connected to a separate control and are left free as soon as the plane gets up speed for the take-off.

There are many types of internal construction used in pontoon floats and flying boat hulls. Generally, though, the bulkhead and compartment style, with longitudinal stringers and cross-bracing is used. In practically all floats the interior is divided up into water-tight compartments.

The reason for this is obvious. Should the hull be punctured, either by a floating log or by rough contact with a rock on the beach, the whole interior of the float will not fill and cause the airplane to sink. Just the one compartment will be flooded, and while it will be hard to get the plane off the water, it is at least safe from sinking.

In racing seaplanes, such as those used in the Schneider Cup races, some of the compartments of the pontoons are often used for gasoline tanks, the fuel being lifted to the carburetors by means of pumps. This is an example of the clever designing that is done on these world's record ships. You will notice, too, the excellent streamlines of these racing planes and their pontoons.

In addition even more important in connection with our talk about pontoons and floats, notice that the pontoons of these racing planes are very long in proportion to the size of the planes. Take a tip from that, model builders. The average model designer, when first he builds a flying model seaplane, generally makes his floats much too short, with the unfortunate result that his plane either noses over or tips backward in the water. It is imperative to have sufficient fore-and-aft buoyancy to get a good measure of longitudinal stability.

We have merely touched the high spots of seaplane float design. The subject, in itself, is an art and a science—and a highly interesting one to the person who makes a close study of its many phases and branches.

Model Air Motor

(Continued from page 22)

cylinders are now attached in manner shown in sketch No. 7. These side frames are made from 1/32" sheet brass by cutting and filing to shape. See sketch No. 8.

Care must be taken in the use of solder. Do not apply more solder than absolutely needed on any part of the engine for a first-class sweating, as a surplus of this material only means an added weight to the finished motor. Bend tubing for conveying compressed gas (or air) to motor in accordance with sketch No. 5. Solder these tubes in place. See sketch No. 7.

The rotary valve is constructed of aluminum, if possible, if not, brass can be used but adds to weight of finished product. Lap in carefully as this valve also serves as the motor bearing. Enlarged details shown in sketch No. 9 clearly describe construction of this important part.

Secure the rotary valve in position on the general motor assembly as in sketch No. 10. This valve must be set in correct position as shown in valve timing diagram No. 11.

The crank shaft is made up from parts shown in sketches No. 12, web No. 13, shaft No. 14, crank pin and assembled as in No. 15. The crank shaft and rotary valve are assembled as in No. 10 with connecting rods on the crank pin.

This completes the motor. It may be mounted on the nose of the plane by binding it around the cylinders with button thread and doping same to the longerons and verticles of the motor mount.

Tanks for holding compressed air or carbonic acid gas may be obtained from any model supply house at reasonable cost.

New and practical methods of furnishing these engines with compressed carbonic acid gas will be described in some later issue.

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1/16 x 3/8	.02	6 for .10
1/16 x 1/2	.02½	7 for .15
1/16 x 3/4	.03	8 for .20
1/16 x 1	.03	8 for .20
3/32 x 3/32	.01	6 for .05
3/32 x 1/8	.01	6 for .05
3/32 x 1/4	.02	6 for .10
3/32 x 1	.04	8 for .20
1/8 x 1/8	.01	6 for .05
1/8 x 5/32	.01	6 for .05
1/8 x 3/16	.01½	6 for .05
1/8 x 1/4	.02	6 for .05
1/8 x 5/16	.02	6 for .10
1/8 x 3/8	.02	6 for .10
1/8 x 1/2	.02½	6 for .10
1/8 x 3/4	.03	8 for .20
1/8 x 1	.04	8 for .25
1/8 x 1 1/2	.05	8 for .25
1/8 x 1 1/4	.04	8 for .25
1/8 x 1 3/4	.07	4 for .15
5/32 x 5/32	.02	6 for .10
3/16 x 3/16	.01½	11 for .15
3/16 x 1/4	.02	6 for .10
3/16 x 5/16	.02	6 for .10
3/16 x 3/8	.02	6 for .10
3/16 x 7/16	.03	8 for .20
3/16 x 1/2	.03	8 for .20
3/16 x 3/4	.04	4 for .15
3/16 x 1	.04½	5 for .20
1/4 x 3/16	.03	8 for .20
1/4 x 1/4	.02	6 for .05
1/4 x 5/16	.03	8 for .20
1/4 x 3/8	.03	8 for .20
1/4 x 1/2	.03½	8 for. 25
1/4 x 3/4	.04½	5 for .20
1/4 x 1	.05	6 for .25
5/16 x 5/16	.03½	8 for .25
3/8 x 3/8	.05	6 for .25
3/8 x 7/16	.05	6 for .25
3/8 x 1/2	.05	6 for .25
3/8 x 3/4	.06½	5 for .30
3/8 x 1	.08	4 for .30
7/16 x 7/16	.06½	5 for .30
3/8 x 1	.08	4 for .30
1/2 x 1/2	.07	3 for .20
1/2 x 5/8	.10	3 for .25
1/2 x 3/8	.10	3 for .25
1/2 x 3/4	.10	3 for .25
1/2 x 1	.09	3 for .25
1 x 1	.17	2 for .30
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1/16 x 1/16	.01½	5 for .07
1/8 x 1/8	.02	6 for .10
1/8 x 3/8	.03	8 for .20
1/8 x 1/2	.03	8 for .20
1/8 x 3/4	.04	4 for .15
1/8 x 1	.05	6 for .25
3/16 x 3/8	.03	8 for .20
3/16 x 1/2	.04	4 for .15
1/4 x 1/4	.04	4 for .15
3/16 x 1/2	.04	4 for .15
1/4 x 1/4	.04	4 for .15
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3/16 x 2"	.09
3/16 x 3"	.13
1/4 x 2"	.11
1/4 x 3"	.16
3/8 x 2"	.19
3/8 x 3"	.28

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⅝ x ¾ x 7½	.02	¾ x 1⅛ x 11	.04
¾ x ¾ x 7½	.02	⅞ x 1½ x 11	.06
½ x ⅝ x 6	.01½	⅝ x 1¼ x 12	.06
½ x ¾ x 5	.02	⅞ x 1½ x 12	.07
½ x ¾ x 6	.02	1 x 1⅜ x 12	.08
⅝ x 1 x 7	.02	1 x 1½ x 13	.09
⅝ x 1 x 8	.02½	⅞ x 1½ x 14	.09
⅞ x 9/8 x 10	.03	⅝ x 1⅜ x 16	.12

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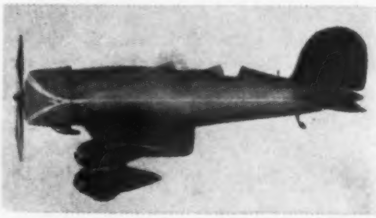

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